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Application of a national administrative case definition for the identification of pre-existing diabetes mellitus in pregnancy

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Abstract

Introduction: Accurate ascertainment of pregnant women with pre-existing diabetes allows for the comprehensive surveillance of maternal and neonatal outcomes associated with this chronic disease.

Method: To determine the accuracy of case definitions for pre-existing diabetes mellitus when applied to a pregnant population, a cohort of women who were pregnant in Nova Scotia, Canada, between 1991 and 2003 was obtained from a population-based provincial perinatal database, the Nova Scotia Atlee Perinatal Database (NSAPD). Person-level data from administrative databases using hospital discharge abstract data and outpatient physician services data were linked to this cohort. Various algorithms for defining diabetes mellitus from the administrative data, including the algorithm suggested by the National Diabetes Surveillance System (NDSS), were compared to a reference standard definition from the NSAPD.

Results: Validation of the NDSS case definition applied to this pregnant population demonstrated a sensitivity of 87% and a positive predictive value (PPV) of 66.4%. Use of ICD-9 and ICD-10 diagnostic codes among hospitalizations with diabetes mellitus in pregnancy showed important increases in sensitivity and PPV, especially for those pregnancies delivered in tertiary centres. In this population, pregnancy-related administrative data from the hospitalization database alone appear to be a more accurate data source for identifying pre-existing diabetes than applying the NDSS case definition, particularly when pregnant women are delivered in a tertiary hospital.

Conclusion: Although the NDSS definition of diabetes performs reasonably well compared to a reference standard definition of diabetes, using this definition for evaluating maternal and perinatal outcomes associated with diabetes in pregnancy will result in a certain degree of misclassification and, therefore, biased estimates of outcomes.

Keywords: diabetes mellitus, pregnancy, validation studies

Introduction

Monitoring the prevalence and incidence of diabetes, estimating the burden of illness, and evaluating the impact of care on prevention and progression are essential for planning and evaluating treatment and prevention programs for chronic disease.[1,2] Increasing maternal age[3] and changing maternal characteristics such as pre-pregnancy weight[4,5] may contribute to increasing rates of pre-existing diabetes in pregnant women,[6] with associated increased costs related to diabetes care.[7] Obstetrical complications associated with pre-existing diabetes also have important maternal and neonatal consequences.[6,8-11] Accurate ascertainment of pregnant women with pre-existing diabetes allows for the comprehensive surveillance of maternal and neonatal outcomes associated with this complication.

The identification of diabetes cases in the population using administrative data began in Canada in 1991, followed by the development of a provincial diabetes database in Manitoba in 1998.[12] To be labelled as having diabetes, a person must have recorded two physician claims within a two-year period or one hospitalization with a diagnosis of diabetes. With further refinement related to age threshold, and clarification of the claim date, the National Diabetes Surveillance System (NDSS) established an algorithm for the collection of national data related to diabetes.[13] The NDSS is a collaborative network of provincial and territorial surveillance systems. Supported by the Public Health Agency of Canada, it was developed in 2001 to improve the breadth of information about the burden of diabetes in Canada so that policy makers, public health and health care professionals and the general public can make better public and personal health decisions. At the provincial level, the NDSS compiles administrative health care data relating to individual diabetes cases and sends aggregate anonymous data to the Public Health Agency of Canada for national analyses.[14]

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Validation studies have evaluated the NDSS case definition for the detection of diabetes mellitus in the general population as well as a more liberal definition that requires only one physician visit or hospitalization. They have compared these definitions to reference standards such as provincial health surveys, diabetes registries, medical charts and laboratory data.[2,15] The results of these validation studies have been inconsistent as measured by ascertainment rate[12] or sensitivity,[15-19] which may be related to regional, temporal or reference standard definitions.[12,15-19] In addition, the utility of the NDSS in sub-populations such as pregnancy becomes challenging when diagnoses of gestational diabetes are also considered. The NDSS is limited in its ability to distinguish between type 1, type 2 and gestational diabetes, and although gestational diabetes has its own ICD-9* and ICD-10† codes, increases in the prevalence of pre-existing diabetes among women of child-bearing years (20–49 years) may be the result of changing maternal characteristics, such as increasing pre-pregnancy weight,[4] or the result of miscoding.[14,20] To eliminate gestational diabetes cases that were miscoded with a diabetes mellitus code, the NDSS case definition excludes women first meeting the case definition for diabetes 120 days preceding or 90 days after any pregnancy-related visit.

Previous validation studies used to develop a Nova Scotia diabetes repository demonstrated an unacceptably high number of false positive diagnoses of diabetes mellitus using the NDSS case definition in the general population.[21] The purpose of our study was to evaluate the application of the NDSS case definition for diabetes mellitus using data derived from administrative databases to a population of pregnant women, and to compare this application to a clinical definition for the diagnosis of pre-existing diabetes in pregnancy using data derived from a reference standard perinatal database.

Methods

The province of Nova Scotia has a homogeneous, predominantly Caucasian population of about one million, with approximately 10 000 live births each year.[22] The population of Nova Scotia has universal health coverage with a single payer health system within Canada. Although nine hospitals offer intrapartum obstetrical care, 50% of deliveries occur at one of the tertiary maternity facilities.

Data sources and linkage

Information on all women who delivered in Nova Scotia between 1988 and 2003 is available from the Nova Scotia Atlee Perinatal Database (NSAPD), which is managed by the Reproductive Care Program (RCP) of Nova Scotia. The NSAPD is a high quality, provincial population-based database containing clinical information on all births born at a gestational age of at least 20 weeks or having a birth weight of at least 500 grams. It contains maternal and newborn information, such as demographic variables, procedures, interventions, maternal and newborn diagnoses and morbidity, and mortality information for every pregnancy and birth in Nova Scotia since 1988. Home births without hospital admission are currently not entered into the database. (However, there are few home births, approximately 0.2% per year.) Information in the database is abstracted by trained health records personnel using standardized forms and hospital medical records across Nova Scotia. Detailed information on several hundred variables is collected on specific lifestyle and other subject characteristics, medical conditions, labour and delivery events and neonatal outcomes. All information is entered into the database soon after the time of collection. In addition to the routine data checks and edits that are made at the time of collection, an ongoing data quality-assurance program, which carries out periodic rigorous abstraction studies, has shown that the information in the database continues to be reliable. In particular, the information collected on pre-existing diabetes was considered the reference standard for the diagnosis of diabetes for this study because cases were clinically confirmed and accurately coded.[21] The database has been used previously for numerous studies, including diabetes-related studies,[9,23,24] and has been used to validate other sources of data.[25]

The data from the NSAPD were linked to the two administrative health databases relevant to this study, the Canadian Institute for Health Information's Discharge Abstract Database (CIHI-DAD) and the Medical Services Insurance (physician visits) Database (MSID). The administrative databases are housed at the Population Health Research Unit (PHRU), Department of Community Health and Epidemiology, Dalhousie University, and include population-level administrative health data for the Province of Nova Scotia. These administrative data are obtained from provincial billing information (MSI) and recorded from hospital medical records abstracted by trained health records personnel. Nine facilities provide regional or tertiary level obstetrical services in Nova Scotia; in 6 of these facilities, the data abstractor who codes and abstracts information is the same coder for both CIHI-DAD and NSAPD data, while in 3 facilities, the data are collected for the CIHI system and the NSAPD system by two different individuals. Each data abstractor is registered with the Canadian Health Information Management Association and is qualified for and knowledgeable about data collection in either system for data collection.

These health databases capture all diagnosed cases of diabetes in both outpatient and hospital settings. The CIHI-DAD contains information on medical diagnoses and procedures from hospital discharge data. Discharges are coded using ICD-9 codes for 1987 to 2001 and ICD-10 codes since 2001; surgical and other procedures are coded using the Canadian Classification of Procedures for 1987 to 2001 and the Canadian Classification of Health Interventions for 2001 to the present day. The MSID records outpatient visits and diagnoses through physician billing, including information on physician specialty. In Nova Scotia, clinical fees for obstetrical services are coded separately for prenatal visits, admission to hospital, care for labour and delivery, and postpartum care.

* *International Classification of Diseases, 9th Revision.*

† *International Classification of Diseases, 10th Revision.*

NSAPD (reference-standard) criteria

Since inception, the NSAPD has defined pre-existing diabetes in pregnancy using the White classification, then ICD-10-CA (Canada) or CCI (Canadian Classification of Health Interactions) code, and finally the NSAPD code for diabetes mellitus during a pregnancy-related admission (Table 1a).[26] However, during this study, we used only the White classification, which considers duration of diabetes and the presence of vascular, retinal and renal complications of diabetes mellitus.[27] Pre-existing diabetes in pregnancy is coded in the NSAPD when it is identified anywhere in the patient record, regardless of whether the diagnosis was of an outpatient or an inpatient. The NSAPD case definition is able to distinguish gestational diabetes mellitus (White classification, Class A) from pre-existing type 1 or type 2 diabetes mellitus (White classification Class B-T).

NDSS criteria

The case definition used by the NDSS for the diagnosis of diabetes mellitus requires that an individual have either at least one hospitalization or at least two medical claims coded with a diagnosis of diabetes mellitus (250 in ICD-9 or E10–E14 in ICD-10, Table 1b) within two years (Algorithm A, Table 2). To meet the two MSI physician claims requirements, the claims could not occur on the same day. These case definitions are applied to all patient-level claims, irrespective of age or gestational status.[20] To eliminate miscoding of gestational diabetes cases as diabetes mellitus, and because birth date information is not available to NDSS, the NDSS case definition distinguishes pre-existing diabetes mellitus from gestational diabetes by removing any cases with a diagnostic code for diabetes mellitus (Table 1b) that occur 120 days before or 90 days after any pregnancy-related visit (relevant obstetrical claims codes summarized in Table 1b). The NDSS case definition includes type 1 and type 2 diabetes mellitus but is unable to distinguish between types.

The NDSS case definition was applied to this study population using all coding fields in the hospital discharge data for any hospital admission in pregnancy and

TABLE 1A
Diagnostic codes used to define pregnancies with pre-existing diabetes in the NSAPD

Diagnostic codes	Year of use
White Classification	1988–2003
Class A: Gestational diabetes	
Class B: Less than 10 years duration; no vascular disease; onset after age 20 years	
Class C: Duration 10–19 years; minimal vascular disease; onset after age 10 years	
Class D: Duration 20 years or more; benign retinopathy; onset before age 10 years	
Class F: Patient with Class D and nephropathy	
Class R: Patient with proliferative retinopathy	
Class T: Diagnosis made by level of glucose challenge test equal to or greater than 10.3 mmol/l	
ICD-10-CA or CCI	2003–2006
NSAPD code	2006–present

Abbreviations: CCI, Canadian Classification of Health Interactions; ICD-10-CA, *International Classification of Diseases, 10th Revision, Canadian version*; NSAPD, Nova Scotia Atlee Perinatal Database.

TABLE 1B
Diagnostic codes used in the application of the National Diabetes Surveillance System case definition for pre-existing diabetes to pregnancies in the NSAPD

	Diabetes mellitus codes	Obstetrical codes	Diabetes mellitus in pregnancy codes
ICD-9[a]	250	640–669	648.0
ICD-10[b]	E10–E14	O265, O290–O30, O318, O320–O369, O40–O439, O60–O669, O680–O849, O890–O899, O904, O908, O95–O97, Z354–Z356	O24.0, O24.1, O24.2, O24.3, O24.9

Abbreviations: ICD-9, *International Classification of Diseases, 9th Revision*; ICD-10, *International Classification of Diseases, 10th Revision*; NSAPD, Nova Scotia Atlee Perinatal Database.

[a] In use 1987–2001.

[b] In use 2001–present day.

TABLE 2
Algorithms based on the application of the NDSS case definition for diabetes mellitus to pregnancies in the NSAPD, or existing diagnostic codes for diabetes in pregnancy using CIHI-DAD and MSI

Algorithm	Definition
A (NDSS)	removes cases with at least one hospitalization or at least two MSI claims with a diagnostic code for diabetes mellitus (ICD-9 250 or ICD-10 E10–14) that is followed within 120 days, or 90 days after, by an obstetrics claims code
B	removes cases with at least one hospitalization or at least two MSI claims with a diagnostic code for diabetes mellitus (ICD-9 250 or ICD-10 E10–14) that is followed within 150 days, or 90 days after, by an obstetrics claims code
C	removes cases with at least one hospitalization or at least three MSI claims with a diagnostic code for diabetes mellitus (ICD-9 250 or ICD-10 E10–14) that is followed within 120 days, or 90 days after, by an obstetrics claims code
D	includes cases with at least one hospitalization with a diagnostic code for diabetes mellitus during pregnancy (ICD-9 648.0 or ICD-10 O24.0, O24.1, O24.2, O24.3, O24.9)
E	algorithm A or algorithm D

Abbreviations: CIHI-DAD, Canadian Institute for Health Information's Discharge Abstract Database; ICD-9, *International Classification of Diseases, 9th Revision*; ICD-10, *International Classification of Diseases, 10th Revision*; MSI, Medical Services Insurance; NDSS, National Diabetes Surveillance System; NSAPD, Nova Scotia Atlee Perinatal Database.

physician claims data for the study period. The NSAPD began coordinating data collection in Nova Scotia in 1988; however, since the databases at the PHRU only included data beginning April 1, 1989, and to allow for a two-year period before a pregnancy (NDSS case definition includes two medical claims codes within two years), the study period included all pregnancies between April 1, 1991, and December 2003. In Nova Scotia, ICD-9 was replaced by ICD-10 in the CIHI-DAD, beginning April 1, 1997; however, MSI coding with respect to billing continued in ICD-9.

Statistical analysis

All pregnancies in the NSAPD (i.e. ≥ 20 weeks gestation and births ≥ 500g) between April 1, 1991, and April 1, 2003, that resulted in live-birth singletons were considered for analysis. Because diabetes status in pregnancy may change over time, only the diabetes status for a nulliparous pregnancy recorded in the NSAPD was considered. A pregnant woman must also have been eligible to receive MSI (i.e. did not move out of province or die) during a period at least two years before the start of pregnancy to 90 days after the delivery date to ensure sufficient time to meet the NDSS case definition. Since the administrative databases began in April 1, 1989, the earliest delivery date was April 1, 1991. The delivery date, which was determined from the NSAPD, was not used in the administrative definitions, but was used only to place the cases in the appropriate time intervals. Only patient obstetrical and diabetes records were retained.

Analyses compared the reference standard to two modifications of the application of the NDSS case definition to this pregnant population (Algorithm B and C, Table 2) and two alternate definitions using administrative databases (Algorithm D and E, Table 2). Algorithm B removed diabetes mellitus claims followed within 150 days by an obstetrical claim (instead of 120 days used in the NDSS definition) to identify a case of pre-existing diabetes mellitus. Algorithm C required three (not two) MSI physician claims (within two years) or one hospital claim to identify a case of pre-existing diabetes mellitus. Algorithm D was defined by using only hospitalizations with ICD-9 and ICD-10 diagnostic codes specific for diabetes mellitus in pregnancy (Table 1b) for the duration of the study (1991–2003) from the CIHI-DAD, because the fourth digit for the ICD-9 code 648, which distinguishes pre-existing diabetes in pregnancy (ICD-9 648.0) from gestational diabetes (ICD-9 648.8), only became available for MSI physician claims in Nova Scotia on March 31, 1996. Algorithm E required either the application of the original NDSS case definition to this pregnant population or at least one hospitalization with ICD-9 and ICD-10 diagnostic codes specific for diabetes mellitus in pregnancy (based on the model with either algorithm A or D). The analysis was also done for each algorithm separating the cohort into those who delivered in tertiary hospitals from those that delivered in non-tertiary (regional or community) hospitals, and also into two time periods, before and after April 1, 1997.

The development and maintenance of study databases such as those used in this study is consistent with the Tri-Council's guidelines pertaining to database linkages under their Code of Ethical Conduct for Research Involving Humans. This research project received approval from the IWK Health Centre Research Ethics Board and from the Joint Data Access Committee of the RCP of Nova Scotia.

Results

Linkage of the NSAPD and the administrative databases housed by the PHRU, which included the CIHI-DAD and MSI, yielded 41 533 nulliparous pregnancies in the NSAPD with corresponding hospitalization and outpatient physician visit administrative codes. There were 8.4% less women in the PHRU eligibility file compared to the data file derived from the NSAPD.

Table 3 summarizes the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for the evaluation of each algorithm of the NDSS case definition used in comparison with the reference standard diagnosis. During the study period, 200 women with pre-existing diabetes mellitus were identified using the NSAPD, while 262 women who met inclusion criteria were identified as having pre-existing diabetes mellitus by applying the NDSS case definition (Algorithm A). The estimated prevalence in the study population was 0.48% (95% CI 0.42–0.55) using data from the NSAPD and 0.63% (95% CI 0.56–0.71) using administrative data based on the NDSS case definition (31% higher prevalence in the NDSS). Based on the reference standard, the NDSS case definition of diabetes had a sensitivity of 87.0%, specificity of 99.8%, PPV of 66.4% and NPV of 99.9%. There were 88 pregnancies falsely identified as having pre-existing diabetes when applying the NDSS case definition compared to the reference standard. Of these 88 pregnancies, 22 were diagnosed by the NSAPD as having gestational diabetes. The NSAPD does not collect information on glucose intolerance in pregnancy.

The consequences of variations in components of the NDSS case definition are summarized in Table 3. Modification of the NDSS case definition to remove women diagnosed with diabetes 150 days preceding any pregnancy-related visit (Algorithm B) slightly reduced the number of false positive cases of diabetes mellitus to 84, but also decreased the sensitivity to 84.5% compared to the NSAPD. Modification of the NDSS case definition removing women with diabetes codes 120 days preceding or 90 days after any pregnancy-related visit using three MSI codes (Algorithm C) reduced the number of pregnancies falsely identified as having diabetes mellitus to 50, with a concurrent slight decrease in sensitivity to 82.5% compared to the NSAPD.

When testing the algorithm that used diagnostic codes specifically for diabetes mellitus in pregnancy among hospitalizations (Algorithm D), we found that 228 pregnancies had at least one hospitalization with a diagnostic code for diabetes mellitus in pregnancy during the study period, while 200 pregnancies were identified by the NSAPD as having pre-existing diabetes mellitus. Compared to the reference standard, 51 pregnancies were falsely identified with diabetes mellitus, with a sensitivity of 88.5%, specificity of 99.9%, PPV of 77.6% and NPV of 99.9% (Table 3).

When testing Algorithm E (based on the model with either algorithm A or D), sensitivity was increased to 92.0% but PPV was decreased to 60.1% (Table 3).

Categorization by type of delivery hospital (tertiary versus non-tertiary) showed higher sensitivity and PPV for deliveries within a tertiary hospital (n = 26 165) for all of the algorithms compared to all pregnancies combined or to deliveries in non-tertiary hospitals (n = 15 368; Table 3). The best performance was for Algorithm D for deliveries in a tertiary hospital, where the sensitivity was 98.0% and PPV was 82.0%. Poorer performance was seen when applied to deliveries in non-tertiary hospitals. The prevalence was lower than the entire study population when deliveries occurred in non-tertiary hospitals (0.31%) and higher when deliveries occurred in tertiary hospitals (0.59%).

Categorization by period (before April 1, 1997, n = 20 993, or equal to or later than April 1, 1997, n = 20 540) showed a very slightly higher sensitivity in the later time period, but poorer PPV (71.3% in the earlier time period versus 63.4% in the later time period), with application of the NDSS case definition (algorithm A) (Table 4). For all the other algorithms, only small differences were observed in the test characteristics between the two time periods (Table 4). The prevalence was lower than the entire study population when deliveries occurred in the first period (0.40%) and higher when deliveries occurred in the second (0.57%).

TABLE 3
Test characteristics of the NDSS case definition compared to the NSAPD (reference standard) for nulliparous pregnancies, by type of delivery hospital, Nova Scotia, 1991–2003

Algorithm		Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)
A (NDSS)	All pregnancies	87.0 (81.4–91.1)	99.8 (99.7–99.8)	66.4 (60.3–72.0)	99.9 (99.9–99.9)
	Delivery in a non-tertiary hospital	72.3 (57.1–84.0)	99.8 (99.7–99.8)	46.6 (35.0–58.6)	99.9 (99.9–100)
	Delivery in a tertiary hospital	91.5 (85.6–95.2)	99.8 (99.6–99.8)	74.1 (67.1–80.0)	99.9 (99.9–100)
B	All pregnancies	84.5 (78.6–89.1)	99.8 (99.8–99.9)	66.8 (60.6–72.5)	99.9 (99.8–100)
	Delivery in a non-tertiary hospital	70.2 (54.9–82.2)	99.8 (99.8–99.8)	46.5 (34.7–58.6)	99.9 (99.9–100)
	Delivery in a tertiary hospital	88.9 (82.6–93.2)	99.8 (99.7–99.8)	74.7 (67.7–80.7)	99.9 (99.9–99.9)
C	All pregnancies	82.5 (76.4–87.4)	99.9 (99.8–99.9)	76.7 (70.4–82.1)	99.9 (99.8–99.9)
	Delivery in a non-tertiary hospital	68.1 (52.8–80.1)	99.9 (99.8–99.9)	68.1 (52.8–80.5)	99.9 (99.9–100)
	Delivery in a tertiary hospital	86.9 (80.3–91.6)	99.9 (99.8–99.9)	82.6 (75.7–88.0)	99.9 (99.9–100)
D	All pregnancies	88.5 (83.1–92.4)	99.9 (99.8–99.9)	77.6 (71.6–82.8)	99.9 (99.9–100)
	Delivery in a non-tertiary hospital	57.4 (42.3–71.4)	99.9 (99.8–99.9)	60.0 (44.4–73.9)	99.9 (99.8–99.9)
	Delivery in a tertiary hospital	98.0 (93.9–99.5)	99.9 (99.8–99.9)	82.0 (75.5–87.1)	100.0 (100–100)
E	All pregnancies	92.0 (87.1–95.2)	99.7 (99.7–99.8)	60.1 (54.4–65.6)	100.0 (99.9–100)
	Delivery in a non-tertiary hospital	72.3 (57.1–83.9)	99.6 (99.5–99.7)	38.2 (28.3–49.2)	99.9 (99.9–100)
	Delivery in a tertiary hospital	98.0 (93.9–99.5)	99.7 (99.7–99.8)	69.1 (62.5–75.1)	100.0 (100–100)

Abbreviations: CI, confidence interval; NDSS, National Diabetes Surveillance System; NPV, negative predictive value; NSAPD, Nova Scotia Atlee Perinatal Database; PPV, positive predictive value.

TABLE 4
Test characteristics of the NDSS case definition compared to the NSAPD (reference standard) for nulliparous pregnancies, by period, Nova Scotia, 1991–2003

Algorithm		Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)
A (NDSS)	Delivery before April 1, 1997	85.7 (76.0–92.1)	99.9 (99.8–99.9)	71.3 (61.3–79.6)	99.9 (99.9–100)
	Delivery April 1, 1997, or later	87.9 (80.3–93.0)	99.7 (99.7–99.8)	63.4 (55.4–70.7)	99.9 (99.9–100)
B	Delivery before April 1, 1997	81.0 (70.6–88.4)	99.9 (99.5–99.6)	71.6 (61.3–80.1)	99.9 (99.9–100)
	Delivery April 1, 1997, or later	87.1 (79.3–92.3)	99.7 (99.6–99.8)	63.9 (55.9–71.3)	99.9 (99.9–100)
C	Delivery before April 1, 1997	79.8 (69.3–87.4)	99.9 (99.8–99.9)	79.8 (69.3–87.4)	99.9 (99.9–100)
	Delivery April 1, 1997, or later	84.5 (76.3–90.3)	100.0 (99.9–100)	74.8 (66.3–81.8)	99.9 (99.9–100)
D	Delivery before April 1, 1997	82.1 (71.9–89.3)	99.9 (99.8–99.9)	72.6 (62.4–81.0)	99.9 (99.9–100)
	Delivery April 1, 1997, or later	93.1 (86.4–96.8)	99.9 (99.8–99.9)	81.2 (73.3–87.3)	99.9 (99.9–100)
E	Delivery before April 1, 1997	89.3 (80.2–94.7)	99.8 (99.7–99.8)	61.5 (52.2–70.0)	100.0 (99.9–100)
	Delivery April 1, 1997, or later	94.0 (87.5–97.3)	99.6 (99.5–99.7)	59.2 (51.8–66.3)	100.0 (99.9–100)

Abbreviations: CI, confidence interval; NDSS, National Diabetes Surveillance System; NPV, negative predictive value; NSAPD, Nova Scotia Atlee Perinatal Database; PPV, positive predictive value.

Discussion

Accurate identification of a population with diabetes quantifies the burden of disease, but also contributes to the evaluation of disease management and outcomes associated with diabetes. Studies employing the NDSS case definition for the diagnosis of diabetes mellitus in the general population have demonstrated high ascertainment rates with the original case definition,[12] but have improved at estimating incidence by adding clearance periods to minimize the inclusion of prevalent cases,[18] by modifying the number of hospitalizations or physician visits in the NDSS criteria,[2,18] or by adding clinical data to the original case definition.[2,16,17,19] The application of the NDSS case definition to a subpopulation such as pregnancy is challenging. We demonstrated that applying the NDSS case definition to a pregnant population underestimated true cases of pre-existing diabetes mellitus (sensitivity 87%) and a high number of false positive cases (PPV 66%). The prevalence of pre-existing diabetes mellitus among pregnant women in Nova Scotia was 0.5% using the reference standard, lower than the general female population in Canada as identified by the NDSS (0.7%–2.5% in 2006–2007 in women of child-bearing age).[11] Grouping by type of delivery hospital increased both the sensitivity and the PPV for those delivering in a tertiary hospital, but usually resulted in poorer results for non-tertiary hospitals. The algorithm employing only hospitalization diagnostic codes for pre-existing diabetes in pregnancy (Algorithm D) among women delivering in tertiary centres performed the best, with sensitivity 98%, specificity 99.9%, PPV 82%, and NPV 100% compared to the reference standard (NSAPD). However, using an algorithm which excludes both outpatients and non-tertiary hospitals would limit the province-wide assessment of diabetes in pregnancy needed for programming and making policy decisions.

The false positive cases identified by applying the NDSS case definition to the studied pregnant population in Nova Scotia may reflect coding errors or misdiagnosis, such as coding glucose intolerance as diabetes in administrative data. The low PPV suggests a high potential for misclassifying non-diabetic individuals as having diabetes mellitus. Implications of this misclassification become apparent when potential uses of the administrative data are considered. For an outcome study on the effect of pre-existing diabetes on birth outcomes, this degree of misclassification would be a major source of bias; if an administrative definition of pre-existing diabetes was used as part of a risk adjustment in a study in pregnancy examining an additional risk factor, then the misclassification would result in residual confounding. However, since the prevalence of pre-existing diabetes mellitus is small (0.5%–0.6%), the residual confounding resulting from misclassification would be small from the perspective of absolute numbers of misclassified women. In addition, if the administrative definition was used descriptively to measure the prevalence of pre-existing diabetes in pregnancy, the degree to which the misclassification biases the prevalence estimates should be taken into account. The influence of misclassification bias in understanding results using large administrative databases was recently highlighted in a cohort evaluation of the identification of diabetes mellitus in Ontario.[28] The authors emphasized the need for verifying the accuracy following the mass application of identification criteria to minimize misclassification bias, compared to regularly validated data collection employed by electronic databases such as the NSAPD.

Evaluation of the NDSS case definition applied to a population of pregnant women using the NSAPD demonstrated higher sensitivity and PPV for women who delivered at tertiary centres compared to those delivered at non-tertiary hospitals. Pregnancies complicated by severe diabetes mellitus may be preferentially delivered at a tertiary maternity facility, introducing severity bias into the assessment of the NDSS case definition. This difference in level of hospital for delivery may also represent variability in coding practice among centres. Additionally, specialists and subspecialists involved in the care of pregnant women with diabetes may be more likely to accurately code for pre-existing diabetes mellitus than general practitioners, as has been demonstrated with other systemic diseases outside of pregnancy and where medical care unrelated to the disease is required.[29,30]

A switch from the ICD-9 to ICD-10 coding system occurred in April 1997 in Nova Scotia, but despite this factor, the study interval did not affect the operating characteristics. This observation may be a result of improved coding as coders gained experience with new coding systems,[31] balanced with increasing reimbursement for medical services using alternate funding programs established by the government of Nova Scotia. This change in the environment of funding, with a variable requirement for shadow billing to document clinical care, may have resulted in decreased accuracy in coding. In particular, there was a growth in alternate funding programs in the tertiary care centres in Nova Scotia in later years of the study. Alshammari and Hux demonstrated that detection of chronic disease is more likely with hospitalization, but that these diseases are less likely to be detected in surveillance programs dependent on administrative data algorithms in non-fee-for-service settings.[16] Chronic diseases such as diabetes mellitus are treated largely on an outpatient basis, and surveillance efforts are heavily dependent on outpatient physician services claims. In the NDSS, nearly 75% of cases are detected by physician claims alone.[16] For this population of women who delivered in Nova Scotia hospitals, the hospitalization code for pregnancies complicated by pre-existing diabetes is a more accurate method for identifying diabetes mellitus than the NDSS case definition. The addition of this hospitalization code (for pregnancies complicated by pre-existing diabetes) to the NDSS definition for the general population should increase sensitivity; however PPV may decrease.

The validation of administrative databases typically occurs with medical record audits, and results of validation studies have varied depending on the type of administrative data (inpatient versus outpatient and diagnostic versus procedural), specific disease area and codes used for case identification, and disease severity.[32] Some provinces continue to use three-digit coding, which may decrease the PPV. Employing administrative databases for

the ascertainment of diagnoses is challenging in light of varying coding practices and the accuracy and comprehensiveness of data sources.[33,34] The NSAPD is a validated database[35] and has been used to validate perinatal data in the CIHI-DAD.[18] It is considered a reference standard component of the Nova Scotia Diabetes Repository.[21] The population-based nature of the administrative databases and the NSAPD in this study limits the selection bias that may occur with single-centre validation studies. In addition, health surveillance increases in pregnancy, reducing rates of undiagnosed diabetes.[9,23] It would be important to validate the NDSS case definition using other perinatal database sources to rule out a regional bias in the comparison population,[18] and to assess coding quality and the coding environments in different provinces and regions.[29]

A limitation to this validation study includes the introduction of new provincial health card numbers after 1995. Before this time, women had their father's (if under 18) or their husband's (if married) social insurance number plus a suffix, for a health card number (HCN), while after 1995 they were assigned their own HCN. Both the PHRU and the RCP have optimized mapping of the old to the new HCN; however, there may be occurrences where mapping is incomplete. This would lead to women appearing in the data as left censored or lost to follow-up when the old MSI number is changed, and would underestimate the prevalence of pre-existing diabetes.

The PPV of case definitions derived from administrative data is highly dependent on the prevalence of diabetes mellitus in the population to which they are applied. Accordingly, as prevalence decreases, more stringent case definitions are required in order to have an acceptable PPV.[27] In this study, the hospitalization code for pregnancies complicated by pre-existing diabetes performed the best. Other modifications could include the addition of clinical or laboratory data to improve detection.[37]

Conclusion

Validation of the NDSS case definition using the NSAPD as the reference standard diagnosis demonstrated adequate sensitivity but low positive predictive values. In the Nova Scotia pregnant population, administrative data using the ICD-9 and ICD-10 codes for diabetes mellitus in pregnancy from the CIHI-DAD (hospitalization database) alone appear to be a more accurate data source for the identification of pre-existing diabetes than the application of the NDSS case definition, particularly when pregnant women are delivered in a tertiary hospital. Although the NDSS definition of diabetes performs reasonably well compared to a reference standard definition of diabetes, using this definition for evaluating maternal and perinatal outcomes associated with diabetes in pregnancy will result in a certain degree of misclassification and, therefore, biased estimates of outcomes.

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Divergent associations between incident hypertension and deprivation based on different sources of case identification

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Abstract

Introduction: Studies suggest that hypertension is more prevalent in the most deprived. Our objective was to examine the association between incident hypertension and deprivation in Quebec based on different modes of case identification, using two administrative databases.

Methods: We identified new incident cases of hypertension in 2006/2007 in the population aged 20 years plus. Socio-economic status was determined using a material and social deprivation index. Negative binomial regression analyses were carried out to examine the association between incident hypertension and deprivation, adjusting for several covariates.

Results: We found a positive and statistically significant association between material deprivation and incident hypertension in women, irrespective of the identifying database. Using the hospitalization database, the incidence of hypertension increased for both sexes as deprivation increased, except for social deprivation in women. However, whether using the physician billing database or the validated definition of hypertension obtained by combining data from the two databases, the incidence of hypertension decreased overall as deprivation increased.

Conclusions: Associations between hypertension and deprivation differ based on the database used: they are generally positively associated with the hospitalization database and inversely with the standard definition and the physician billing database, which suggests a consultation bias in favour of the most socio-economically advantaged.

Keywords: hypertension incidence, socio-economic status, administrative databases

Introduction

About 1 in 5 people have been diagnosed with arterial hypertension in Quebec, a proportion similar to that of the entire population of Canada.[1,2] Moreover, the prevalence of hypertension increased by 29% in Quebec between 2000/2001 and 2006/2007 and by 57% in Canada between 1998/1999 and 2007/2008.[1,2] The incidence remained comparatively stable at the Canadian level, whereas it decreased slowly in Quebec, from approximately 31 per 1000 population in 2000/2001 to 25 per 1000 population in 2006/2007.[3] The divergence between the change in prevalence and incidence over time is most likely due to a decline in mortality, probably as a result of better treatment and control.[1,3] Because it is strongly associated with cardiovascular, renal and cerebrovascular diseases, suboptimal blood pressure is the risk factor associated with the greatest mortality in developed countries.[4] Although an important cause of mortality and morbidity,[5] hypertension is also a condition that can be modified.[6-8] In fact, apart from age, sex, family antecedents and ethnic origin, most risk factors for hypertension—overweight, physical inactivity, high salt and alcohol consumption and smoking[9-11]—are associated with lifestyle. It is also well accepted that some of these risk factors are unequally distributed, usually at the expense of those with lower socio-economic status (SES).[9,12]

Several studies suggest at least a partial link between SES, particularly material deprivation,[13] and hypertension. This link remains statistically significant even when adjusting for lifestyle characteristics[9,11,14] and is often more pronounced in women.[9] However, Tu et al. found no association between income alone and incident hypertension in Ontario.[15] Research that examined the social component of deprivation[13] found an association between social deprivation and hypertension.[16-19] Most of the studies reviewed were cross-sectional and examined more specifically the relationship between prevalent hypertension and SES.

Our objective was to examine the association between incident hypertension and material and social deprivation in Quebec based on different modes of case identification, using two administrative databases. We expected to find a tendency similar to the one identified in the literature, namely, an inverse association between SES and incident hypertension that is more

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pronounced in women. We hypothesized that the most materially and socially advantaged people would present a lower incidence of hypertension, possibly as a result of a healthier lifestyle.[5,9] We also supposed that this association would differ based on the administrative database used to identify the cases. In fact, we predicted that the hypertensive cases identified only on the hospitalization database present more comorbidities and a lower SES.

Methods

Study population and data sources

Our study population was aged 20 years and more, lived in Quebec between 2006-04-01 and 2007-03-31, and was identified as newly hypertensive based on a validated definition of hypertension[3] that is used in Ontario[10] and Quebec[1] and by the Public Health Agency of Canada.[3,11] The data used to identify hypertension cases were drawn from two administrative files, the physician billing and the hospitalization databases. The physician billing database compiles every medical procedure billed to the Régie de l'assurance maladie du Québec whereas the hospitalization database provides information about the principal diagnosis and up to 15 or 25 secondary diagnoses, depending on the year of compilation. ICD-10* codes have been used in the hospitalization database since 2006-04-01, whereas the ICD-9† codes are still used in the physician billing database. The socio-demographic information from both databases is also found in the health insurance registry database. The data used are based on a longitudinal follow-up of hypertension since 1996-01-01.[1]

Case definition

The case definition of hypertension selected ("standard definition") corresponds to the following criteria: one hospitalization or two or more physician claims within two years, identified by one or more of the hypertension-related diagnoses codes: 401, 402, 403, 404 or 405 in ICD-9 or I10, I11, I12, I13 or I15 in ICD-10. This case definition has, according to a validation study conducted in Ontario, a sensitivity of 72%, a specificity of 95%, and a positive and negative predictive value of 87% and 88%, respectively.[3] According to this definition, the codes associated with hypertension identified within the 120 days preceding or 180 days following an obstetrical event (641–676 or V27 in ICD-9 or O1, O21–O95, O98, O99 or Z37 in ICD-10) are excluded as they could be related to pregnancy-induced hypertension. In order to verify that the associations differed based on the source of case identification, the hypertensive individuals identified with the physician billing database were separated from those identified with the hospitalization database.

Deprivation index

As the administrative databases contain neither psychosocial nor material characteristics, we used the material and social deprivation index, a geographical proxy of the SES containing six indicators that can be linked to the administrative databases by postal code.[12,13] These six indicators reflect the two types of deprivation, which were assigned to the individuals living within each census dissemination area. The material deprivation is determined by 1) the proportion of persons who have no high-school diploma; 2) the ratio of employment to population; and 3) average personal income. The social deprivation is determined by the proportion of 1) persons who are separated, divorced or widowed; 2) people living alone; and 3) single-parent families. With the exception of the last category, these indicators are adjusted for the age and sex.[13] Each of the two components of the index is divided into quintiles, the most deprived people in the population being in the fifth quintile (Q5).

Statistical analysis

An exploratory descriptive analysis compared the profile of individuals in the general population with one identified as newly hypertensive. We used a negative binomial regression to examine the association between incident hypertension and material and social deprivation. Two models were used: the first included patients identified as newly hypertensive based on the standard definition, and the second distinguished the patients based on their identification database (hospitalization database versus physician billing database). The analysis was adjusted for age and geographical area of residence, and stratified for sex. The 2001 census was used as a reference for the adjustment of incidence rates for age. Analysis of material deprivation was adjusted for social deprivation, and vice versa. The reference group was the most advantaged (Q1). Interaction between age and sex and between deprivation and sex were verified. The statistical threshold for the analyses was $p < .05$. All the analyses were conducted using the statistical package SAS, version 9.1.3 (SAS Institute Inc.).

Results

The deprivation index could be assigned to 92% of our newly hypertensive cohort. Those who were unassigned did not have a permanent address or lived in areas where the index could not be attributed (as a result of being very small census geographical units, very sparsely populated or on Cree or Inuit territories and including health or social services institutions of more than 75 beds).[13] Approximately 20% of the cases were identified with the hospitalization database and 80% with the physician billing database. Table 1 shows that 45% of the general population (≥ 20 years) was aged between 20 and 44 years. In spite of being the largest in size, this age group had the smallest number of newly hypertensive cases, irrespective of the definition used.

Table 2 shows approximately 20% of the population in each deprivation quintile, as expected. The subsequent exclusion from each quintile of people aged less than 20 years and those for whom no deprivation index could be assigned explains why each does not represent exactly 20% of the population. Using the standard definition, and after excluding the most advantaged quintile (Q1), the incidence of hypertension decreased as the level of material deprivation increased. The association was the same for social deprivation, but the increase was

* *International Classification of Diseases, 10th Revision.*

† *International Classification of Diseases, 9th Revision.*

TABLE 1
Distribution of the study population according to method of case identification and age-specific incidence rate, 2006/2007, Quebec, Canada

Age, years	All adults aged ≥ 20 years		Method of case identification					
			Standard definition of hypertension		Hospitalization database		Physician billing database	
	n	%	n[a]	ASIR (per 1000)	n	ASIR (per 1000)	n	ASIR (per 1000)
20–44	2 686 955	45.28	12 958	4.97	1 065	0.41	11 677	4.60
45–64	2 172 123	36.60	45 121	26.71	6 922	3.87	37 609	26.70
≥ 65	1 075 101	18.12	30 754	71.28	9 701	12.36	20 584	56.02

Abbreviation: ASIR, age specific incidence rate.

Note: The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

[a] The number of people identified with the standard definition is not the sum of the people identified with the hospitalization database and the physician billing database; around 4% of the people are identified with both databases. These 4% are only included in the standard definition.

TABLE 2
Characteristics of study population according to the method of case identification and age-adjusted incidence rate, 2006/2007, Quebec, Canada

	All adults aged ≥ 20 years		Method of case identification					
			Standard definition of hypertension		Hospitalization database		Physician billing database	
	n	%	n	AAIR (per 1000)	n	AAIR (per 1000)	n	AAIR (per 1000)
Material deprivation								
Q1 (most advantaged)	1 067 990	19.99	16 527	31.19	2 763	2.91	13 661	20.57
Q2	1 063 965	19.92	16 969	33.15	2 999	3.23	13 827	21.27
Q3	1 072 000	20.07	17 449	31.49	3 371	3.38	13 887	20.01
Q4	1 072 410	20.08	17 457	30.36	3 653	3.58	13 664	19.20
Q5 (most disadvantaged)	1 065 005	19.94	17 233	28.09	4 247	4.18	12 924	17.31
Social deprivation								
Q1 (most advantaged)	1 009 705	18.90	16 576	17.13	1 029	1.65	13 459	22.31
Q2	1 033 605	19.35	16 813	32.59	3 218	3.52	13 470	20.36
Q3	1 060 605	19.86	17 564	30.93	3 454	3.46	13 994	19.83
Q4	1 097 045	20.54	17 885	29.59	3 541	3.29	14 215	19.40
Q5 (most disadvantaged)	1 140 410	21.35	16 797	26.69	3 791	3.51	12 825	16.98
Sex								
Women	3 036 049	51.16	42 434	23.18	7 321	2.71	34 463	21.00
Men	2 898 130	48.84	46 199	25.76	10 367	4.72	35 407	20.61
Geographical area								
Montreal	2 518 670	47.15	41 061	37.63	7 967	3.57	34 718	23.39
CMAs[a]	1 028 885	19.26	16 188	37.94	2 926	3.19	13 192	22.42
Agglomerations[b]	644 670	12.07	10 446	32.51	2 314	3.76	8 094	19.33
Rural[c]	1 149 145	21.51	18 410	26.41	4 481	3.97	13 866	16.38

Abbreviations: AAIR, average age adjusted incidence rate; CMA, census metropolitan area; Q, quintile.

Notes: Q1 = most advantaged; Q5 = most disadvantaged

The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

[a] Other census metropolitan areas, populations ≥ 100 000 inhabitants (Quebec, Sherbrooke, Trois-Rivières, Saguenay and Gatineau).

[b] Mid-size cities, population 10 000–100 000 inhabitants.

[c] Small towns and rural settings, populations < 10 000.

larger and steadier. The associations differ when we take into account the database used for case identification: using the hospitalization database, hypertension increases as material deprivation increases, whereas the association is less pronounced for social deprivation; for cases identified with the physician billing database, hypertension decreases as the level of material and social deprivation increases, the same as with the standard definition. Men identified with the hospitalization database show an incidence of hypertension almost twice that of women (4.72 per 1000 population versus 2.71 per 1000 population) (see Table 2). The incidence rate of hypertension is higher in urban areas with the standard definition and with the physician billing database than with the hospitalization database.

Table 3 shows the results of the multivariate analyses. We did not find any statistically significant interactions between each type of deprivation and method of case identification, that is, physician billing database or hospitalization database. As the interaction between age and sex was statistically significant (p = .0011), the results are stratified by sex. The results obtained with the standard definition showed a positive association between age and incident hypertension for both sexes, with the oldest age group (≥ 65 years) having a relative risk of hypertension 7 times that of the youngest age group (20–44 years). Figure 1 shows the same positive associations between age and hypertension with the hospitalization and physician databases. Women and men in the oldest age group (≥ 65 years) have an adjusted incidence rate of hypertension 24 and 29 times, respectively, that of those in the youngest group (20–44 years) when identified with the hospitalization database. The positive association between age and hypertension is less pronounced when using the physician billing database (relative risk [RR] = 5 times).

As in Table 3, Figure 2 shows a positive and statistically significant association between material deprivation in women and incidence of hypertension, as defined by the standard definition (RR_{Q5} = 1.15). The association between social deprivation and incident hypertension in women is the opposite (RR_{Q5} = 0.83) to that of material deprivation, and is statistically significant only for Q4 and Q5. There was no significant association between material deprivation and the incidence of hypertension in men, but social deprivation influences the incidence of hypertension for men in the same way as for women (RR_{Q5} = 0.87), the association also being statistically significant only for Q4 and Q5.

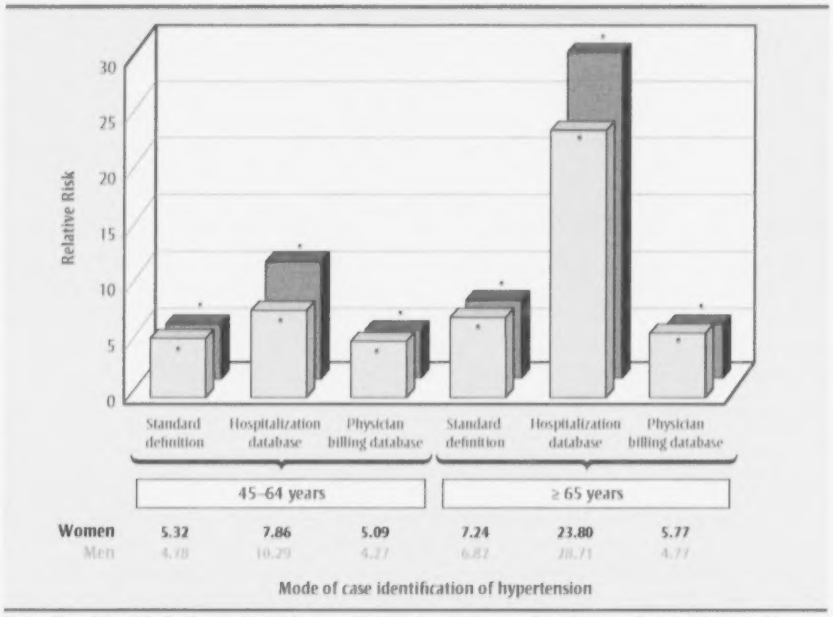
For cases identified with the hospitalization database (Table 3 and Figure 3), there is a positive and statistically significant association between material deprivation and the incidence of hypertension in women (RR_{Q5} = 1.60), though the association between incident hypertension and social deprivation is not statistically significant. In men, the association between the incidence of hypertension and material deprivation is also positive, but it is statistically significant only for Q3 to Q5 (RR_{Q5} = 1.29). The association between incident hypertension and social deprivation in this group is positive but statistically significant only for the most deprived quintile (RR_{Q5} = 1.14).

When incident cases are identified with the physician billing database (Table 3 and Figure 4), the associations are similar to those found using the standard definition. In women, the positive association between material deprivation and hypertension is weak and statistically significant only for Q3 to Q5 (RR_{Q5} = 1.07). In contrast, there is an inverse association between hypertension and social deprivation that is statistically significant only for Q4 and Q5 (RR_{Q5} = 0.80). In men, the association between material deprivation and the incidence of hypertension is inversely related but statistically significant only for the most deprived quintile, Q5 (RR_{Q5} = 0.94), while the level of social deprivation is, as for women, inversely associated with incident hypertension and statistically significant only for Q3 to Q5 (RR_{Q5} = 0.81).

Discussion

Our results demonstrate divergent associations between the incidence of hypertension and deprivation in people aged 20 years and more in Quebec during

FIGURE 1
Adjusted relative risk of men and women by the standard definition of hypertension and methods of case identification, by age, 2006/2007, Quebec, Canada



Notes: The relative risks for the people aged between 20–44 years were chosen as the reference and are not shown in this graph. The relative risks for the 45–64 and ≥65 years age groups were adjusted for the level of material and social deprivation and the area of residence.

The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

* Statistically significant results, $p < .0001$.

TABLE 3
Relative risk of male and female study population according to the method of case identification, by age, geographical area of residence, and material and social deprivation, 2006/2007, Quebec, Canada

	Method of case identification								
	Standard definition of hypertension			Hospitalization database			Physician billing database		
	RR	95% CI	*p*	RR	95% CI	*p*	RR	95% CI	*p*
Women									
Age, years									
20–44 (ref)	1.00	–	–	1.00	–	–	1.00	–	–
45–64	5.32*	5.10–5.55	<.0001	7.86*	7.02–8.82	<.0001	5.09*	4.87–5.33	<.0001
≥ 65	7.24*	6.93–7.56	<.0001	23.80*	21.30–26.64	<.0001	5.77*	5.51–6.04	<.0001
Geographical area									
Montreal (ref)	1.00	–	–	1.00	–	–	1.00	–	–
CMAs[a]	0.89*	0.85–0.93	<.0001	0.86*	0.79–0.94	.0011	0.90*	0.86–0.94	<.0001
Agglomerations[b]	0.89*	0.85–0.93	<.0001	1.05	0.95–1.16	.3127	0.86*	0.82–0.90	<.0001
Rural[c]	0.82*	0.78–0.85	<.0001	1.04	0.95–1.14	.4389	0.78*	0.74–0.82	<.0001
Material deprivation									
Q1 (most advantaged) (ref)	1.00	–	–	1.00	–	–	1.00	–	–
Q2	1.06*	1.00–1.12	.0321	1.13*	1.01–1.26	.0375	1.05	0.99–1.11	.0712
Q3	1.07*	1.02–1.13	.0091	1.18*	1.05–1.32	.0040	1.06*	1.00–1.12	.0364
Q4	1.10*	1.04–1.16	.0004	1.32*	1.18–1.48	<.0001	1.06*	1.01–1.13	.0292
Q5 (most disadvantaged)	1.15*	1.09–1.21	<.0001	1.60*	1.43–1.79	<.0001	1.07*	1.01–1.14	.0153
Social Deprivation									
Q1 (most advantaged) (ref)	1.00	–	–	1.00	–	–	1.00	–	–
Q2	0.97	0.92–1.02	.2367	1.01	0.90–1.12	.9182	0.97	0.91–1.02	.2152
Q3	0.95	0.91–1.00	.0589	0.99	0.89–1.10	.8381	0.95	0.90–1.00	.0671
Q4	0.92*	0.88–0.97	.0012	0.95	0.85–1.06	.3653	0.92*	0.87–0.97	.0023
Q5 (most disadvantaged)	0.83*	0.79–0.88	<.0001	1.04	0.93–1.16	.4553	0.80*	0.76–0.85	<.0001
Men									
Age, years									
20–44 (ref)	1.00	–	–	1.00	–	–	1.00	–	–
45–64	4.78*	4.62–4.96	<.0001	10.29*	9.39–11.28	<.0001	4.27*	4.12–4.43	<.0001
≥ 65	6.82*	6.57–7.08	<.0001	28.71*	26.24–31.45	<.0001	4.77*	4.59–4.96	<.0001
Geographical area									
Montreal (ref)	1.00	–	–	1.00	–	–	1.00	–	–
CMAs[a]	0.90*	0.87–0.93	<.0001	0.91*	0.85–0.98	.0089	0.90*	0.86–0.93	<.0001
Agglomerations[b]	0.89*	0.86–0.93	<.0001	1.05	0.98–1.13	.1859	0.84*	0.81–0.88	<.0001
Rural[c]	0.87*	0.84–0.90	<.0001	1.06	0.99–1.14	.0737	0.81*	0.78–0.85	<.0001
Material deprivation									
Q1 (most advantaged) (ref)	1.00	–	–	1.00	–	–	1.00	–	–
Q2	1.01	0.96–1.05	.8265	1.08	1.00–1.18	.0579	0.99	0.95–1.04	.8244
Q3	1.01	0.96–1.06	.6954	1.15*	1.06–1.25	.0010	0.99	0.94–1.03	.5721
Q4	1.00	0.96–1.05	.8563	1.18*	1.09–1.29	<.0001	0.97	0.93–1.02	.2441
Q5 (most disadvantaged)	1.00	0.96–1.05	.8354	1.29*	1.18–1.40	<.0001	0.94*	0.90–0.99	.0213
Social Deprivation									
Q1 (most advantaged) (ref)	1.00	–	–	1.00	–	–	1.00	–	–
Q2	0.98	0.94–1.02	.2931	1.02	0.94–1.10	.6976	0.97	0.93–1.01	.1850
Q3	0.97	0.93–1.01	.1351	1.05	0.97–1.14	.2184	0.95*	0.91–1.00	.0322
Q4	0.93*	0.89–0.97	.0011	1.05	0.97–1.13	.2579	0.91*	0.86–0.95	<.0001
Q5 (most disadvantaged)	0.87*	0.83–0.91	<.0001	1.14*	1.05–1.24	.0015	0.81*	0.77–0.85	<.0001

Abbreviations: CI, confidence interval; ref, reference; RR, relative risk; Q, quintile.

Note: Q1 = most advantaged; Q5 = most disadvantaged.

The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

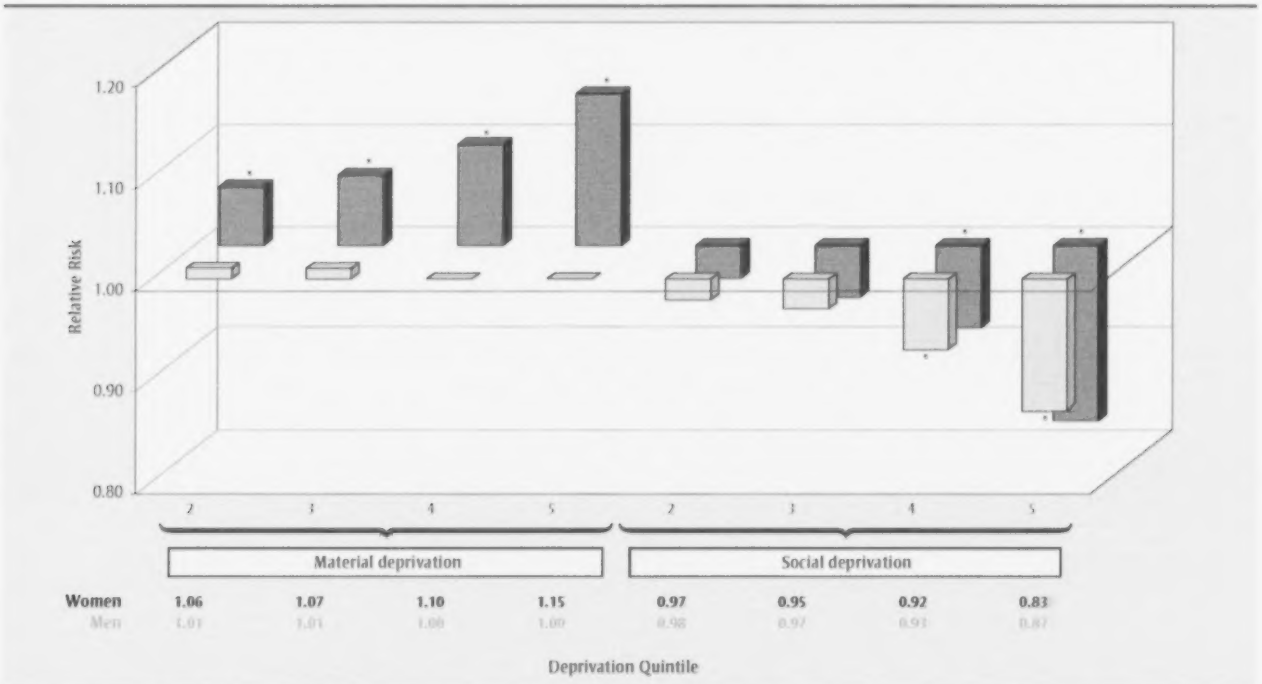
[a] Other census metropolitan areas, populations > 100 000 inhabitants (Québec, Sherbrooke, Trois-Rivières, Saguenay and Gatineau).

[b] Mid size cities, population 10 000–100 000 inhabitants.

[c] Small towns and rural settings, populations < 10 000.

* Statistically significant results, $p \leq .05$.

FIGURE 2
Adjusted relative risk of men and women by the standard definition of hypertension and material and social deprivation, 2006/2007, Quebec, Canada



Notes: The relative risks for the first quintile (Q1) of material and social deprivation (the most advantaged) were chosen as the reference and are not shown in this graph. These relative risks were also adjusted for age and the geographical area of residence.

The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

* Statistically significant results, $p \leq .05$.

the fiscal year 2006/2007. These associations vary based on the source of case identification, the type of deprivation, and sex. Associations between the incidence of hypertension and deprivation are generally positive when individuals were identified with the hospitalization database as opposed to the physician billing database or the standard definition. Associations made with the hospitalization database are also more pronounced and more constant than those made with the physician billing database.

Several of the associations observed in our study differ from those found in the literature.[10,11,16,17] To explain the unexpected results for cases identified with the physician billing database or with the standard definition, it is important to emphasize that the definition of hypertension we chose involves medical consultations, whereas most other studies reviewed relied mainly on surveys. Our results suggest that the most advantaged people visit a doctor in a medical practice more frequently, increasing the likelihood of identifying hypertension, which results in a consultation bias with more frequent identification of hypertension. However, the research varies on this issue.[20,24] Our results show that material deprivation is associated with a decrease in the incidence of hypertension in men identified with the physician billing database. Pineault et al. found that individuals identified with cardiovascular risk factors, including hypertension, were more likely to be older, male and less educated.[24] However, even if the risk factor group had difficulty accessing primary care services, access was not statistically different compared to other users.[24]

On the other hand, some studies showed that individuals with a lower SES use ambulatory medical services more frequently.[25,26] However, these ambulatory visits reflect both emergency room and medical office visits, two very different types of physician consultations. Although both are included in the physician billing database, the people who rely on the emergency room visits are probably less likely to benefit from the long-term care required for certain medical conditions including hypertension and thus more likely to experience subsequent hospitalizations due to the deterioration of the medical condition; follow-up medical visits are indeed known to reduce hospitalization.[27] Moreover, an asymptomatic health condition such as hypertension is less likely to be identified as a diagnosis in the physician billing database by emergency doctors compared to family physicians who see a patient as part of a medical follow-up. It is also possible, especially in the emergency room, that the diagnosis of more urgent medical conditions supersedes the hypertension diagnoses for more deprived people who often present with several conditions,[28] which would lead

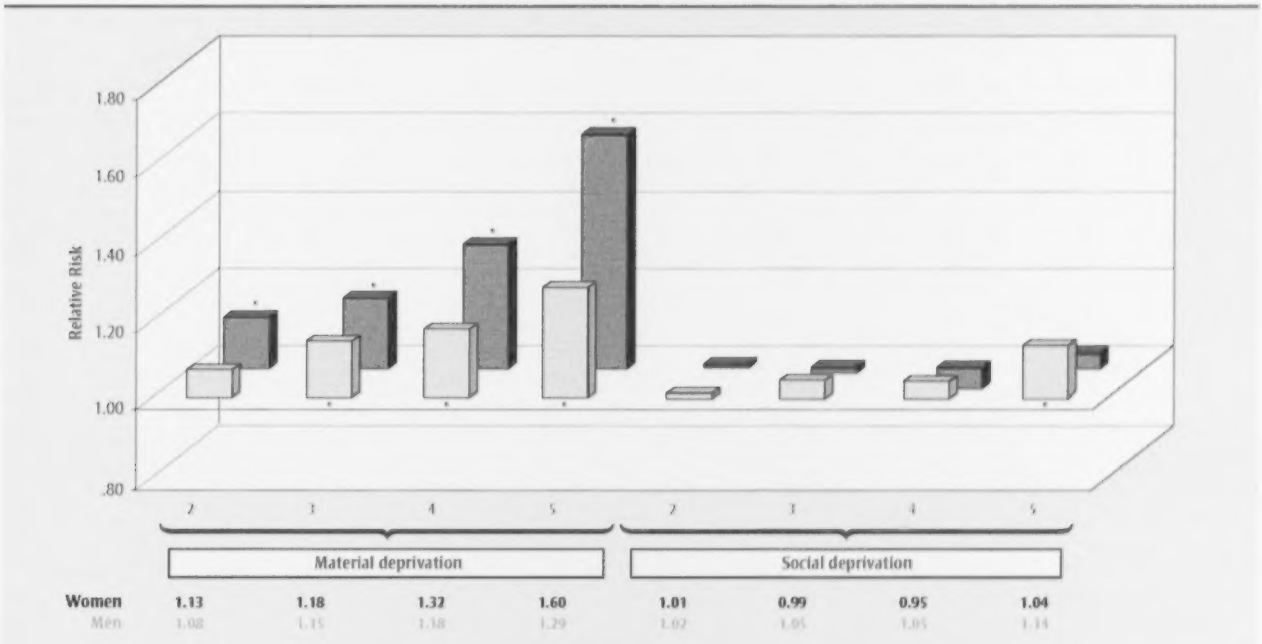
to the frequency of hypertension being underestimated in this group. Interestingly, some studies have suggested that the most socioeconomically deprived individuals are more likely to seek medical care in an emergency context,[29,30] and some authors have shown that these ambulatory consultations were less likely to prevent hospitalization in the most deprived people of the society.[31] Two Canadian studies showed that lower income is positively associated with emergency department visits[32] and inversely associated with continuity of care,[33] which is defined as a "long-term relationship between a patient and a physician or a patient and a physician group, regardless of the presence of any specific disease."[33] However, another Canadian study demonstrated the opposite.[34]

In contrast, the association between material deprivation and hypertension in women shows the same tendency as described in the literature, regardless of the source of case identification. The data suggests that the use of medical services by women is less influenced by material deprivation. In fact, Birch et al. found that women were more likely to have consulted a family physician in the previous year compared with men.[35] Broyles et al. suggested that this was a result of women, especially those of childbearing age, being more heavily involved in maternity and family planning.[36] Medical consultations for cervical cancer screening, renewal of oral contraceptives and, at around age fifty years, breast cancer screening could also be contributing to this phenomenon. Several studies also showed that women were more concerned about and aware of hypertension than men.[37-41]

In addition, Birch et al. found a positive association between the frequency of contacts with friends or relatives and the number of visits to a doctor.[35] Thus, compared to the most socially deprived, the most socially advantaged would be more likely to be diagnosed with a condition such as hypertension. This goes towards explaining the reverse association between social deprivation and hypertension identified with both the physician billing database and the standard definition for both sexes.

According to Billings et al., compared to those living in more advantaged areas, people living in deprived areas tend to delay consulting a physician for the treatment of manageable conditions, which leads to more frequent avoidable hospitalization.[42] This delay may be associated with decreased access to health care services for disadvantaged people, even in a country like Canada with a public health care system. Other studies showed that the most deprived individuals use hospital services more often.[43-45] Since hypertension is a frequent asymptomatic comorbidity,[1,15] it is likely to be omitted from the list of secondary diagnoses collected in the hospital record of patients with several comorbidities. Thus, since the most materially deprived people have more comorbidities,[46] our results may

FIGURE 3
Adjusted relative risk of men and women as identified by the hospitalization database, by material and social deprivation, 2006/2007, Quebec, Canada

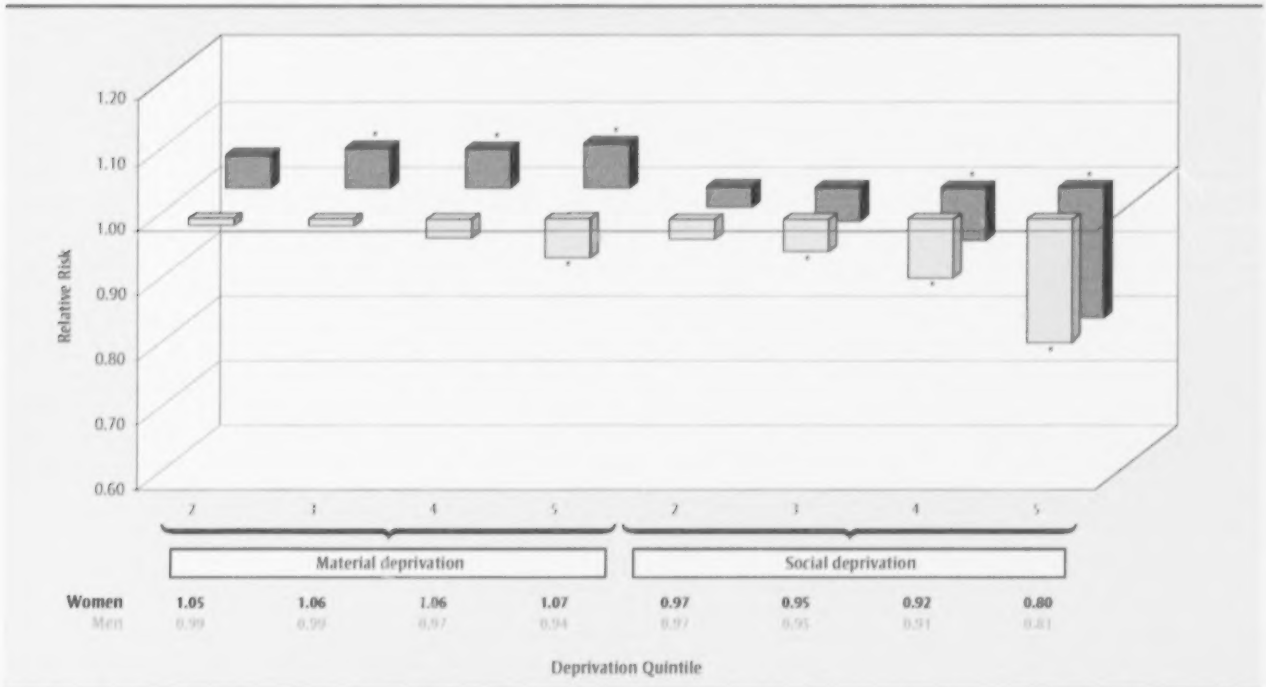


Notes: The relative risks for the first quintile (Q1) of material and social deprivation (the most advantaged) were chosen as the reference and are not shown in this graph. These relative risks were also adjusted for the geographical area of residence and age.

The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

* Statistically significant results, $p \leq .05$.

FIGURE 4
Adjusted relative risk of men and women as identified by the physician billing database, by material and social deprivation, 2006/2007, Quebec, Canada



Notes: The relative risks for the first quintile (Q1) of material and social deprivation (the most advantaged) were chosen as the reference and are not shown in this graph. These relative risks were also adjusted for the geographical area of residence and age.

The study population consists of adults aged ≥ 20 years and newly identified as hypertensive.

* Statistically significant results, $p \leq .05$.

underestimate the positive association found between deprivation and hypertension identified with the hospitalization database.

Limitations

Some limitations are associated with the use of administrative databases, not least that these exclude people with hypertension who have not consulted any health care professionals. The asymptomatic presentation of hypertension probably increases the risk of such a bias, with the detection of hypertension probably varying with SES. Moreover, in their validation study, Tu et al. concluded that the standard definition fails to identify up to 28% of hypertensive patients compared to the consultation of primary care physician charts.[21] However, there is no reason to believe that individuals identified as hypertensive with the primary care physician charts alone are different from those identified with our case definition. The physician billing administrative database is used primarily to compile acts rather than diagnosis, and may therefore miss certain diagnoses such as hypertension; this may partly explain this proportion of unidentified hypertensive patients. However, in our study population, these omissions represent less than 10% of the physician billing acts. It is also important to underline that the deprivation index is not an individual measure of socio-economic conditions, but rather a measure of the conditions at the neighbourhood level. Finally, our data sources relied on two different editions of ICD codes. However, since there was no new ICD code for hypertension between the ninth and the tenth revisions, this difference is not likely to affect our results.

Conclusion

This study reaffirms the importance of considering social and material health inequalities when planning interventions targeted at preventing hypertension. It suggests different health service utilisation based on SES, and thus inequalities in medical detection, treatment and control of hypertension at the expense of the most deprived. In the light of our results, it would be interesting to refine our understanding of primary health care access based on deprivation, to better understand how it varies in different health care settings such as family physicians' practices, walk-in clinics, and emergency care, of which the first is in a much better position to follow up on chronic health conditions. It would also be of value to policy makers to improve our understanding of the potential barriers to health care services and the strategies that can be used to address these, given that universal health care has been in operation in Canada for decades.

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Trends in incidence of childhood cancer in Canada, 1992–2006

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This article has been peer reviewed.

Abstract

Introduction: Cancer is the leading cause of disease-related death in children aged 1 to 14 years in Canada. Despite the importance to public health of childhood cancer, there have been few reports on Canadian trends published in the peer-reviewed literature. This study examines childhood cancer trends by age, sex, and province of residence using the most current cancer registration data.

Methods: Data from the population-based Canadian Cancer Registry were used to compute incidence trends in primary cancers diagnosed between 1992 and 2006 in children (0-14 years) for the 12 major diagnostic groups of the International Classification of Childhood Cancer, 3rd Edition.

Results: Between 1992 and 2006, incidence rates for all cancers remained stable, although trends varied by cancer type. We observed a significant decrease in retinoblastoma in boys for the entire period (−6.5% per year) and an increase in leukemia from 1992 to 1999 (+3.5% per year). In girls, there was a significant decrease in renal tumours from 1998 to 2006 (−5.7% per year) and an increase in hepatic tumours from 1997 to 2006 (+8.1% per year). Differences by age and province were also apparent. Some caution should be exercised when interpreting trends involving a small number of cases per year and those with wide 95% confidence intervals.

Conclusions: Our findings suggest an ongoing need for population-based surveillance and etiologic research.

Keywords: cancer incidence, pediatric, childhood, trends, Canadian Cancer Registry

Introduction

Several large scale epidemiological studies have reported an increase in the incidence of childhood cancers, particularly leukemia and brain tumours.[1-6] An increase in the incidence of all childhood cancers combined has also been observed in Europe and the United States, although recent evidence suggests a plateau in rates.[7,8] It is not clear whether these trends are a real phenomenon or an artefact reflecting changes in diagnostics, case ascertainment, registration practices or differential access to health care.

Although accounting for less than 1% of all cancers diagnosed in Canada, childhood cancers nevertheless pose a significant burden on child health.[9] On average, 850 children aged under 15 years are diagnosed with cancer each year in Canada and 135 die of the disease.[9] Cancer remains the leading cause of disease-related deaths in children aged 1 to 14 years, corresponding to 19% of deaths between 1992 and 2005.[9] The Canadian Late Effects Study shows that in addition to personal loss, childhood cancer can negatively impact the finances of affected families due to loss of income, unpaid care-giving and out-of-pocket expenses associated with treatment.[10,11]

Aside from one 1997 study of neuroblastoma, there have been no peer-reviewed publications on national childhood cancer incidence trends in Canada.[12] A complete picture of trends in childhood cancer would allow for monitoring change over time, estimating burden and prompting etiological research, which in turn would provide information on health care needs. In this report, we aim to provide a detailed analysis of the trends in childhood cancer incidence in Canada in relation to sex, age, and regional differences.

Methods

We used data on cancer incidence from the July 2009 version of the Canadian Cancer Registry (CCR).[13] This dynamic registry contains information on cases diagnosed from 1992 onward, compiled from reports from all provincial and territorial cancer registries in Canada. The reporting of the CCR is assumed to be complete since each Canadian province and territory has a legislated responsibility to collect and control cancer data. Information is available at the patient level and includes date of birth, sex, province and postal code of residence at diagnosis, date and cause of death as well as cancer characteristics such as date of diagnosis, histology (morphology), site of origin (topography) and behaviour classification.[13] Our analysis includes CCR data on all malignant tumours diagnosed in children aged less than 15 years between 1992 and 2006.[14] We based population estimates on quinquennial national censuses conducted from 1986 through 2006; intercensal estimates provided by Statistics Canada were

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used for non-census years. All population estimates have been corrected for census net undercoverage and components of international and interprovincial migration.[15] All rates were age-standardized using the direct method to the 1991 Canadian population.

We classified childhood cancers according to diagnostic categories of the International Classification of Childhood Cancer, 3rd Edition (ICCC-3), a classification system based on the morphology and topography codes used in International Classification of Diseases for Oncology, 3rd edition (ICD-O-3),[16,17] and used the same ICCC-3 abbreviated names for cancer categories. The analysis included all cancers in the ICCC-3 classification system except non-malignant intracranial and intraspinal neoplasms, which are not captured by the Canadian Cancer Registry. All age-standardized incidence rates (ASIRs) were extracted and computed using the statistical package SAS EG version 9.1 (SAS Institute Inc.); trends were characterized by calculating annual percent change (APC) and 95% confidence intervals (CI) using Joinpoint Regression Program, developed by the Surveillance, Epidemiology, and End Results (SEER) Program.[18] Standard linear regression assumptions used the logarithm for the rate assigned as the dependant variable and the midpoint of the calendar year as the independent variable. Permutation-based joinpoint models were used to assess the magnitude and direction of trends, and a maximum of two joinpoints (allowing a minimum of 5 years between joinpoints) was allowed. Significance was determined by calculating two-sided *p*-values to test the slope of the trend line, using $\alpha = 0.05$ as the cut-off for significance.[19] Age-standardized rates and trends were calculated by diagnosis, sex, age group (< 1 year, 1–4 years, 5–9 years, 10–14 years) and province/territory of residence. Neither rates involving fewer than six cases nor trends for cancers with annual rates equal to zero are presented.

Results

Between 1992 and 2006, 13 211 children aged less than 15 years were diagnosed with cancer in Canada, equivalent to an ASIR of 152 cases per million children per year. The most common diagnoses during the 15-year study period were leukemias (32.5% of all cancers diagnosed in children), central nervous system (CNS) tumours (19.9%), lymphomas (11.2%), neuroblastomas (7.3%), soft tissue sarcomas (6.2%), renal tumours (5.7%), and malignant bone tumours (4.5%) (Table 1). The remaining histological categories represented approximately 13% of the total cancer burden in children. The male to female ratio for overall childhood cancer incidence was 1.12 to 1, and there were marked differences in incidence between age groups. The incidence rate was highest in infants (245 cases per million per year), followed by children between the ages of 1 and 4 (213 cases per million per year), 10 and 14 (120 cases per million per year), and 5 and 9 (116 cases per million per year) (Table 1).

The incidence for all childhood cancers combined remained relatively stable for the duration of the study period (see Table 2); however, trends varied by diagnostic category and sex. Incidence of retinoblastoma decreased significantly for the entire period (APC = −2.6% per year, 95% CI = −4.7 to −0.4) and of leukemia increased significantly from 1992 to 1999 (APC = 2.4% per year, 95% CI = 0.0 to 4.9). Incidence of retinoblastoma in boys decreased significantly for the entire period (APC = −6.5% per year, 95% CI = −10.4 to −2.6) and of leukemia increased significantly (APC = 3.5% per year, 95% CI = 1.3 to 5.8). Corresponding trends were not evident in girls; trends for retinoblastoma showed a modest but non-significant decrease and were stable for leukemia. However, incidence of renal tumours in girls decreased significantly between 1998 and 2006 (APC = −5.7% per year, 95% CI = −10.7 to −0.5) while that of hepatic tumours increased significantly between 1997 and 2006 (APC = 8.1% per year, 95% CI = 1.8 to 14.7).

Incidence trends by age (Table 3) revealed a significant increase in renal tumours in children aged less that 1 year between 1992 and 1998 (APC = 18.2% per year, 95% CI = 5.3 to 32.7), followed by a period of non-significant trends. Leukemia rates in children aged 1 to 4 years rose modestly but significantly between 1992 and 1999 (APC = 3.2% per year, 95% CI = 0.3 to 6.1), decreased (albeit insignificantly) between 1999 and 2002, and then increased significantly again between 2002 and 2006 (APC = 4.0% per year, 95% CI = 2.7 to 11.1). In children aged 5 to 9 years, there was a rapid increase in carcinomas (APC = 8.9% per year, 95% CI = 2.2 to 16.1) and germ cell tumours (APC = 10.9% per year, 95% CI = 2.2 to 20.3). In those aged 10 to 14 years, CNS cancers decreased significantly between 1994 and 2004 (APC = −2.3% per year, 95% CI = −4.4 to −0.2). This trend was driven primarily by the decreasing incidence in astrocytomas, which account for over half of the brain tumours in this age group.

We calculated trends for every Canadian province, but not for the sparsely populated territories of Yukon, Northwest Territories and Nunavut. The only province with a significant trend for all cancers combined for the total study period was Alberta (APC = 1.3% per year, 95% CI = 0.2 to 2.4), primarily due to increased incidence of leukemia (APC = 3.1% per year, 95% CI = 0.2 to 6.1) and lymphoma (APC = 6.5% per year, 95% CI = 1.4 to 12.0). Rates for neuroblastoma also increased but not significantly. Leukemia incidence trends increased significantly in Quebec (APC = 1.6% per year, 95% CI = 0.1 to 3.1), while carcinomas, including unspecified malignant epithelial tumours, increased significantly in Ontario (APC = 4.0% per year, 95% CI = 0.0 to 8.2). Intermediate study period analyses found increases in incidence of leukemia in Manitoba between 1996 and 2006 (APC = 3.6% per year, 95% CI = 0.1 to 7.3) and of hepatic tumours in British Columbia between 1992 and 1998 (APC = 12.4% per year, 95% CI = 0.2 to 25.9). Incidence of brain tumours increased in New Brunswick from 1992 to 1998 (APC = 11.9% per year, 95% CI = 3.3 to 21.1) but decreased in Ontario between 1992 and 2004 (APC = −1.5% per year, 95% CI = −2.8 to −0.1). (Additional data available upon request.)

Discussion

While publications reporting trend data from the mid- to late-1970s found that childhood cancer rates have been increasing at a rate

TABLE 1
Number of childhood cancer cases (0–14 years) and average age-standardized incidence rate per million by sex and age group, Canada, 1992–2006

Diagnostic group		Sex		Age group, years				
		Boys	Girls	< 1	1–4	5–9	10–14	All children
	All cancers combined							
	Total number of cases, n	7131	6070	1308	4768	3441	3694	13211
	ASIR, per million	160.7	143.4	245.1	213.1	116.2	120.3	152.3
I	Leukemias							
	Total number of cases, n	2345	1940	264	2060	1175	788	4287
	ASIR, per million	53.1	46.1	49.5	92.1	39.7	25.7	49.7
II	Lymphomas							
	Total number of cases, n	981	499	46	222	426	786	1480
	ASIR, per million	21.4	11.4	8.6	9.9	14.4	25.6	16.5
III	CNS							
	Total number of cases, n	1408	1217	142	820	915	754	2631
	ASIR, per million	31.5	28.5	26.6	36.6	30.9	24.6	30.0
IV	Neuroblastomas							
	Total number of cases, n	498	463	334	475	119	32	960
	ASIR, per million	11.8	11.5	62.6	21.2	4.0	1.0	11.7
V	Retinoblastomas							
	Total number of cases, n	167	156	108	200	11	3	322
	ASIR, per million	4.0	3.9	20.2	8.9	0.3	< 0.1	3.9
VI	Renal tumours							
	Total number of cases, n	343	414	99	436	178	44	757
	ASIR, per million	7.9	10.0	18.6	19.5	6.0	1.4	9.0
VII	Hepatic tumours							
	Total number of cases, n	120	79	49	109	20	22	200
	ASIR, per million	2.8	2.0	9.2	4.9	0.7	0.7	2.4
VIII	Malignant bone tumours							
	Total number of cases, n	304	294	5	50	175	368	598
	ASIR, per million	6.5	6.6	0.9	2.2	5.9	12.0	6.6
IX	Soft tissue sarcomas							
	Total number of cases, n	451	366	84	210	230	292	816
	ASIR, per million	10.0	8.6	15.7	9.4	7.8	9.5	9.3
X	Germ cell tumours							
	Total number of cases, n	201	237	75	91	57	216	439
	ASIR, per million	4.6	5.5	14.1	4.1	1.9	7.0	5.0
XI	Carcinomas and malignant epithelial neoplasms							
	Total number of cases, n	213	295	40	34	96	338	508
	ASIR, per million	4.6	6.7	7.5	1.5	3.2	11.0	5.6
XII	Other/unspecified malignant neoplasms							
	Total number of cases, n	100	110	62	61	39	50	212
	ASIR, per million	2.4	2.7	11.6	2.7	1.3	1.6	2.5

Abbreviations: ASIR, age-standardized incidence rate; CNS, central nervous system.

Note: Diagnostic groups were classified according to the International Classification of Childhood Cancer, 3rd edition (ICCC-3). Rates were directly standardized to the Canadian 1991 population.

TABLE 2
Trends in childhood cancer (0–14 years) by sex, Canada, 1992–2006

Diagnostic group		Trend 1		Trend 2		Trend 3	
		Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
All children							
	All cancers combined	1992–2006	0.0 (−0.5 to 0.4)				
I	Leukemias	**1992–1999**	**2.4 (0.0 to 4.9)**	1999–2002	4.4 (−20.1 to 14.2)	2002–2006	3.0 (−2.6 to 9.0)
II	Lymphomas	1992–2006	0.0 (−1.4 to 1.4)				
III	CNS	1992–2006	−0.4 (−1.3 to 0.5)				
IV	Neuroblastomas	1992–2006	−0.2 (−1.8 to 1.5)				
V	Retinoblastomas	**1992–2006**	**−2.6 (−4.7 to −0.4)**				
VI	Renal tumours	1992–2006	−1.3 (−3.2 to 0.7)				
VII	Hepatic tumours	1992–2006	1.6 (−0.8 to 4.0)[a]				
VIII	Malignant bone tumours	1992–2006	−1.2 (−2.8 to 0.5)				
IX	Soft tissue sarcomas	1992–2006	−1.4 (−3.6 to 0.8)				
X	Germ cell tumours	1992–2006	−0.4 (−2.2 to 1.4)				
XI	Carcinomas and malignant epithelial neoplasms	1992–2006	2.5 (−0.5 to 5.6)				
XII	Other/unspecified malignant neoplasms	1992–2006	4.6 (0.1 to 9.4)[a]				
Boys							
	All cancers combined	1992–1999	1.1 (−0.2 to 2.3)	**1999–2006**	**1.5 (2.7 to 0.3)**		
I	Leukemias	**1992–1999**	**3.5 (1.3 to 5.8)**	1999–2002	6.7 (−20.6 to 9.7)	2002–2006	2.2 (−2.9 to 7.5)
II	Lymphomas	1992–2006	0.2 (−1.6 to 2.0)				
III	CNS	1992–2006	−0.6 (−2.3 to 1.1)				
IV	Neuroblastomas	1992–2006	0.0 (−1.9 to 1.9)				
V	Retinoblastomas	**1992–2006**	**−6.5 (−10.4 to −2.6)**[a]				
VI	Renal tumours	1992–2006	−1.5 (−4.6 to 1.8)				
VII	Hepatic tumours	1992–2006	−1.1 (−4.0 to 1.8)[a]				
VIII	Malignant bone tumours	1992–2006	−0.3 (−2.9 to 2.4)				
IX	Soft tissue sarcomas	1992–2006	−1.8 (−4.8 to 1.3)				
X	Germ cell tumours	1992–2006	−1.1 (−3.8 to 1.6)				
XI	Carcinomas and malignant epithelial neoplasms	1992–2006	3.4 (−1.2 to 8.2)[a]				
XII	Other/unspecified malignant neoplasms	1992–2006	8.4 (−1.8 to 19.7)[a]				
Girls							
	All cancers combined	1992–2006	−0.5 (−1.1 to 0.2)				
I	Leukemias	1992–2006	0.0 (−1.0 to 1.0)				
II	Lymphomas	1992–2006	−0.4 (−2.3 to 1.5)				
III	CNS	1992–2006	−0.6 (−2.2 to 0.9)				
IV	Neuroblastomas	1992–2006	−1.5 (−3.7 to 0.8)				
V	Retinoblastomas	1992–2006	−0.6 (−4.0 to 2.9)				
VI	Renal tumours	1992–1998	3.1 (−5.2 to 12.1)[a]	**1998–2006**	**−5.7 (−10.7 to −0.5)**[a]		
VII	Hepatic tumours	1992–1994	55.6 (−19.1 to 199.1)[a]	1994–1997	−16.6 (−56.6 to 60.2)[a]	**1997–2006**	**8.1 (1.8 to 14.7)**[a]
VIII	Malignant bone tumours	1992–2006	−1.7 (−4.5 to 1.2)				
IX	Soft tissue sarcomas	1992–2006	−1.3 (−2.9 to 0.3)				
X	Germ cell tumours	1992–2006	0.0 (−3.6 to 3.7)				
XI	Carcinomas and malignant epithelial neoplasms	1992–2006	1.9 (−1.0 to 4.9)				
XII	Other/unspecified malignant neoplasms	1992–2006	2.2 (−2.2 to 6.8)[a]				

Abbreviations: APC, annual percent change; CI, confidence interval; CNS, central nervous system.

Note: Significant APC values are bolded. $p < .05$.

[a] Trends involving fewer than 10 cases per year based on rates standardized to the 1991 Canadian population. These should be interpreted with caution.

TABLE 3
Trends in childhood cancer (0–14 years) by age group, Canada, 1992–2006

	Diagnostic group	Trend 1		Trend 2		Trend 3	
		Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
< 1 year							
	All cancers combined	1992–2006	−0.9 (−2.4 to 0.5)				
I	Leukemias	1992–2006	−0.2 (−2.6 to 2.3)				
II	Lymphomas	1992–2006	−4.1 (−10.0 to 2.1)*				
III	CNS	1992–2006	0.7 (−3.8 to 5.3)*				
IV	Neuroblastomas	1992–2006	−1.5 (−4.6 to 1.7)				
V	Retinoblastomas	1992–2006	−4.8 (−9.7 to 0.4)*				
VI	Renal tumours	**1992–1998**	**18.2 (5.3 to 32.7)***	1998–2001	−21.5 (−60.4 to 55.4)*	2001–2006	6.5 (−8.6 to 24.1)*
VII	Hepatic tumours	1992–2006	−0.7 (−8.6 to 7.9)*				
VIII	Malignant bone tumours	1992–2006	—				
IX	Soft tissue sarcomas	1992–2006	0.5 (−5.6 to 7.0)*				
X	Germ cell tumours	1992–2006	0.2 (−5.5 to 6.2)*				
XI	Carcinomas and malignant epithelial neoplasms	1992–2006	—				
XII	Other/unspecified malignant neoplasms	1992–2006	—				
1–4 years							
	All cancers combined	1992–2006	**0.4 (0.0 to 0.9)**				
I	Leukemias	**1992–1999**	**3.2 (0.3 to 6.1)**	1999–2002	−5.2 (−23.2 to 6.9)	**2002–2006**	**4.0 (2.7 to 11.1)**
II	Lymphomas	1992–2006	0.6 (−1.7 to 3.0)*				
III	CNS	1992–2006	1.2 (−1.1 to 3.6)				
IV	Neuroblastomas	1992–2006	−1.5 (−4.7 to 1.8)				
V	Retinoblastomas	1992–2006	−2.1 (−4.8 to 0.6)*				
VI	Renal tumours	1992–2006	3.4 (−0.9 to 7.8)				
VII	Hepatic tumours	1992–2006	−2.2 (−5.3 to 0.9)*				
VIII	Malignant bone tumours	1992–2006	−1.8 (−5.6 to 2.1)*				
IX	Soft tissue sarcomas	1992–2006	2.1 (−6.1 to 10.9)				
X	Germ cell tumours	1992–2006	0.7 (−2.5 to 4.1)*				
XI	Carcinomas and malignant epithelial neoplasms	1992–2006	0.6 (−1.7 to 3.0)				
XII	Other/unspecified malignant neoplasms	1992–2006	—				
5–9 years							
	All cancers combined	1992–2006	0.1 (−0.5 to 0.7)				
I	Leukemias	1992–2006	1.3 (−0.3 to 2.8)				
II	Lymphomas	1992–2006	0 (−2.7 to 2.7)				
III	CNS	1992–2006	−0.9 (−2.4 to 0.6)				
IV	Neuroblastomas	1992–2006	−1.6 (−6.5 to 3.7)*				
V	Retinoblastomas	1992–2006	—				
VI	Renal tumours	1992–2006	−0.6 (−4.4 to 3.4)*				
VII	Hepatic tumours	1992–2006	—				
VIII	Malignant bone tumours	1992–2006	−1.4 (−6.1 to 3.6)*				
IX	Soft tissue sarcomas	1992–2006	−2.0 (−4.7 to 0.9)				
X	Germ cell tumours	**1994–2004**	**10.9 (2.2 to 20.3)***				
XI	Carcinomas and malignant epithelial neoplasms	**1992–2006**	**8.9 (2.2 to 16.1)***				
XII	Other/unspecified malignant neoplasms	1992–2006	—				

Continued on the following page

TABLE 3 (continued)
Trends in childhood cancer (0–14 years) by age group, Canada, 1992–2006

Diagnostic group		Trend 1		Trend 2		Trend 3	
		Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
10–14 years							
	All cancers combined	1992–2006	0.5 (−1.5 to 0.4)				
I	Leukemias	1992–2006	1.2 (−2.6 to 0.3)				
II	Lymphomas	1992–2006	0 (−1.9 to −2.1)				
III	CNS	**1992–2004**	**−2.3 (−4.4 to −0.2)**				
IV	Neuroblastomas	1992–2006	—				
V	Retinoblastomas	1992–2006	—				
VI	Renal tumours	1992–2006	−0.5 (−6.9 to 8.5)[a]				
VII	Hepatic tumours	1992–2006	0.9 (−2.7 to 1.0)[a]				
VIII	Malignant bone tumours	1992–2006	−1.2 (−5.3 to 3.0)				
IX	Soft tissue sarcomas	1992–2006	−0.9 (−5.7 to 4.1)[a]				
X	Germ cell tumours	1992–2006	—				
XI	Carcinomas and malignant epithelial neoplasms	1992–2006	1.9 (−2.2 to 6.3)				
XII	Other/ unspecified malignant neoplasms	1992–2006	—				

Abbreviations: APC, *annual percent change*; CI, *confidence interval*; CNS, *central nervous system*.

Note: Significant APC values are bolded. $p < .05$.

[a] Trends involving fewer than 10 cases per year based on rates standardized to the 1991 Canadian population. These should be interpreted with caution.

of 0.6% per year in the United States (1975–2005)[10] and 1.1% per year in Europe (1978–1997),[11] our findings are consistent with those of reports analyzing more recent data from the United States (1992–2004)[7] and Australia (1983–2007)[8] showing that incidence rates have been levelling off since the early 1990s.

Our analyses show two significant full-period trends: a decrease in retinoblastoma in boys and an increase in carcinomas in children aged 5 to 9 years. Decreasing retinoblastoma trends in infants, the group most affected by this genetically predisposed cancer, were not significant. In comparison, the most recent research on childhood cancer trends in the United States (1992–2004)[7,12] and Europe (1998–2007)[12] shows modest but non-significant increases in incidence of retinoblastoma. The inconsistency with trends observed elsewhere might be due to small numbers of cases. For an extremely rare disease such as retinoblastoma, where the average ASIR over the 15-year study period is 4 cases per million children per year (Table 1), the possibility that the trend may be a chance occurrence due to random fluctuations in annual rates should not be dismissed.

Recent reports from Australia (1983–2006)[8] and Europe (1978–1997)[11] confirm our findings of a rapid rise in carcinomas in 5- to 9-year-olds. Improvement in registration alone does not adequately explain this phenomenon since this is likely to yield consistent increases in incidence across all diagnoses unless there is reason to believe that registry-specific practices would lead to under-reporting or over-reporting of a particular diagnosis. Change in tumour classification also does not explain this trend since an exchange in cases between diagnostic groups is not apparent. Descriptive analysis of CCR data shows that carcinoma incidence increases with age and that carcinomas are very rare in Canadian children aged less than 10 years.[9] It is possible that improvement in diagnostic technologies such as seroassays of tumour markers is inflating the incidence of tumours—previously undetected—in children aged 5 to 9 years, a pattern evident for some subtypes of CNS cancers.[13,14] The rise in pediatric germ cell cancer incidence in 5- to 9-year-olds that we observed is also supported by data from Australia and Europe.[8,11] This trend likely reflects a true phenomenon since there have been no changes to diagnostics, coding, registration or screening practices corresponding to the study period. To better understand the factors that underlie this trend, research should examine changes in underlying risk factors associated with germ cell tumours, such as exposure to exogenous estrogen, prenatal exposure to x-rays and parental exposure to chemicals, solvents, or resins.[15,16]

Our results point to several interesting sub-period trends. These include a significant positive trend in leukemia for boys (1992–1999: APC = 3.5%, 95% CI = 1.3 to 5.8) and an insignificant positive trend in hepatic tumours for girls (1997–2006) as well as an insignificant negative trend in renal tumours for girls (1998–2006). A significant decrease in CNS cancers was also evident in older children aged 10 to 14 years (1994–2004: APC = −2.3%, 95% CI = −4.4 to −0.2). The modest but significant increase in leukemia between 1992 and 1999 (APC = 2.4, 95% CI = 0.0 to 4.9) is compatible with research from Europe[11,17] and the United States.[18] As with other changes described earlier, registration artefacts such as changes in coding practices and legislation are likely not associated with this trend; there is little evidence for the former and the latter is refuted by the lack of uniform trends

across diagnostic categories and sex. Diagnostic interdependence is also an unlikely possibility for this period, and there is no indication that leukemias that would be otherwise captured as lymphomas at a later stage are being captured earlier. Further research should investigate if the positive trends in leukemia specific to boys continue over time and whether they correlate with shifting demographic changes such as the increase in frequency of high birth weight infants in Canada, a phenomenon shown to be positively associated with leukemia and certain types of brain cancers.[29,30] It is also important to note that the increased trends in leukemia in boys versus girls that we observed has been reported in many regions around the world,[31] although factors underlying this phenomenon remain largely unsubstantiated.[32] The rapid increase in unspecified leukemias noted between 1992 and 1999 (in both sexes) implies that a greater number of cases are being grouped in the unspecified category, with the possible result that other leukemia subtypes are being underestimated.

Our study did not have the power to analyse trends in pediatric hepatic cancers by subtype; future research should investigate this given the emerging evidence from some countries that links the rise of hepatoblastoma with increased survival of very low birth weight babies.[33,34] We found a modest but non-significant increase in hepatic cancers, a trend likely driven by annual increases in rates in girls from 1997 onwards (APC = 8.1% per year, 95% CI = 1.8 to 14.7); however, it is not clear why positive trends were detected in girls but not boys even though this cancer tends to occur at a slightly higher rate in the latter.[35,36] We could not confirm significant increases in brain cancer incidence recently reported from the United States.[7] Our data showed stable incidence rates for children aged under 10 years, and significant decreases in 10- to 14-year-olds, a finding that is likely attributed to astrocytomas, a subtype of brain cancer that is known to increase with age.[37] It is worth noting that our analysis was conducted after the wide-scale availability and adoption of magnetic resonance imaging in clinical practice in North America, a tool partially attributed with the increased diagnosis of low-grade gliomas in the early- to mid-1980s in the United States. (The incidence of high-grade gliomas or medulloblastomas, which are more easily detected by computerized tomography scans, did not increase during this period in the United States.[1,38]).

Alberta was the only province with a significant increase in the annual incidence rates for all childhood cancers combined (APC = 1.3%, 95% CI = 0.2 to 2.4). Moreover, histology-specific analyses revealed significant positive trends for leukemia in Quebec (APC = 1.6%, 95% CI = 0.1 to 3.1) and Alberta (APC = 3.1%, 95% CI = 0.2 to 6.1), lymphomas in Alberta (APC = 6.5%, 95% CI = 1.4 to 12.0) and carcinomas in Ontario (APC = 4.0%, 95% CI = 0.0 to 8.2), findings that require investigation in the context of historical changes to registration practices. Although considerable effort has been made to achieve uniformity in defining and classifying new cancer cases in the CCR, reporting procedures and completeness may still vary across the country. The registry in Quebec, for example, relies more heavily on hospitalization data for cancer registration than do other jurisdictions.[3]

Childhood cancer is rare; as a result, trend patterns that appear to be important may in fact be due to random fluctuations. Trends that involve just a few cases per year and those with wide 95% confidence intervals need to be interpreted cautiously. Statistically significant findings may be due to chance and not real changes in incidence rates. Alternatively, true trends may have also been undetected due random fluctuation in incidence rates. Further, it is difficult to understand how underlying risk factors may be influencing trends since the causes of childhood cancer remain poorly understood.[39] About 5% to 15% of childhood cancers may be attributable to familial and genetic factors and less than 5% to 10% to known environmental exposures.[40,41] While we acknowledge that the observed incidence trends may reflect changes in unknown risk factors or random variation, it is encouraging that the overall rates of childhood cancers have remained relatively stable in Canada over the last two decades. Some sex-specific trends, such as increases in leukemia in boys and hepatic cancers in girls, merit further investigation, as do cancers that are increasing in certain age groups, such as germ cell cancers and carcinomas in 5- to 9-year-olds and CNS cancers in 10- to 14-year-olds.

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Cultural factors related to the maintenance of health behaviours in Algonquin women with a history of gestational diabetes

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Abstract

Introduction: Though the cultural factors that may contribute to the diabetes epidemic in First Nations are frequently discussed, little is known about the factors that may help prevent it. In this ethnonursing study, we explore the cultural factors that help maintain health behaviours in Algonquin women who had received a diagnosis of gestational diabetes 2 to 10 years before this study.

Methods: The data were collected in two Algonquin communities through semi-structured interviews with key informants (n = 7) and general informants (n = 8) and through cultural immersion, with detailed observations being recorded into logbooks.

Results: The cultural factors that are likely to affect the prevention of diabetes are the importance of family and social ties, the possibility of preserving cultural values, the opportunity to learn behaviours through educational resources adapted to needs and culture, the chance of saving money through better diet and access to blood sugar data as a means of control.

Conclusion: In the long term, these cultural factors could influence health behaviours and thus help prevent type 2 diabetes.

Keywords: cultural factors, gestational diabetes, Algonquin women, health behaviours, health, type 2 diabetes

Introduction

Gestational diabetes (GD) is an intolerance to glucose that occurs during pregnancy[1] and usually disappears after delivery.[2] It is associated with complications such as macrosomia, toxemia of pregnancy and preeclampsia, which make delivery risky for both mother and baby.[3,4] Further, half of those diagnosed with GD will eventually develop type 2 diabetes.[2,5,6] Interventions support the adoption of health behaviours that keep blood sugar at normal levels, thus reducing the risks of complications for mother and child.[1,4,5,7] However, interventions should take place in a cultural context and be delivered with a knowledge of their cultural significance,[8,10] where culture is defined as "the learned, shared, and transmitted values, beliefs, norms, and lifeways of a particular culture that guides thinking, decisions, and actions in patterned ways"[9].

A number of researchers have studied diabetes (mainly type 2) and cultural dimensions within First Nations and American Indian communities.[10,15] According to these studies, First Nation peoples and American Indians perceive diabetes as a "white disease"[11,13] that is inseparable from the profound socio-economic and political transformations that have characterized the relationship between Aboriginal and non-Aboriginal societies.[12] In fact, the transformation of traditional ways of life has created socio-economic inequalities that have a direct impact on the health of First Nations (e.g. as a result of fewer available natural resources, less consumption of traditional foods and less access to healthy, nutritious foods in some communities).[15] Further, First Nations may have different concepts of health, including a fatalistic view of diabetes.[14] Food is a sign of hospitality, and slimness may be viewed negatively[13] as is physical exercise such as walking.[11,12] Finally, cultural differences are not reflected in treatments designed to modify lifestyles.[13] All these cultural factors are impediments to health behaviours.

In this qualitative study, we undertook to understand the cultural factors that contribute to the maintenance of those health behaviours encouraged during pregnancy in Algonquin women diagnosed with GD. Such an understanding may influence the development of culturally competent care aimed at preserving those behaviours in these women as well as in their children and those around them.

Methods

The ethnographic approach is designed to deepen understanding of a cultural system from the standpoint of those who share this culture.[16] The ethnonursing approach used in this study reveals an individual's lifeways and cultural vision while taking into account context. Ethnonursing aims

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to describe, understand and interpret the meaning of practices, beliefs and values of other cultures.[8,10,17]

Population

The two Algonquin communities (Pikogan and Lac Simon*) in this study were chosen because of their geographical proximity and because the directors of the two community health centres were interested in the study. Pikogan is in an urban setting, while Lac Simon is mainly rural. They are primarily French-speaking, although the Algonquin language is also used. Pikogan is a village located about 3 km from the municipality of Amos. In 2008, out of 551 registered inhabitants, 278 were women.[18] Approximately 52% of the population was aged less than 25 years.[19] Lac Simon is located about 32 km from the municipality of Val-d'Or. Of the 1362 registered inhabitants in 2008, 659 were women,[18] and approximately 61% of the population was aged less than 25 years.[19] The two communities have similar health, educational and community services: both have a health centre, visiting doctors, an elementary school, a daycare, a police station, a church, a community room, a convenience store, a community radio station, a youth centre and buildings belonging to each Band Council. Lac Simon also has a high school, a post office and a restaurant, while Pikogan has a sports arena.

Informant selection and recruitment

An ethnonursing study involves two kinds of participants: key informants and general informants.[8,9] The key informants in this study (n = 7) were directly concerned with the issue: they had been diagnosed with GD and had received care in their community health centre (Table 1). Inclusion criteria were the following: Algonquin; aged 18 years plus; diagnosed with GD 2 to 10 years before the start of this study; received health care in the Algonquin community when given the diagnosis of GD; neither breastfeeding nor pregnant during the study. The key informants were recruited by three of the general informants.

For reasons of anonymity, age and education are not given, though mean age was 34 years (range: 29–40 years) and half had not completed high school. We assigned each key informant a fictitious given name similar to those used in the two communities in the order of the interviews. Thus, the first person interviewed at Lac Simon was assigned the letter A and given a name starting with *a* (e.g. Amy), and so on until *d*. To differentiate from them, the women of Pikogan were given fictitious names that began with *i* and continued until *k* (see Table 1).

General informants have a more general view of the issue. They were introduced to us by the resource people who, in turn, were our first point of contact in the communities. General informants were willing to speak freely of their experience with the community and to give feedback on the participant observation notes. A total of 8 people were consulted as general informants: 4 nurses, a nutritionist, a social worker, a nursing assistant and a dental hygienist; 2 were First Nations and 6 worked in Lac Simon. They had between several months and eight years of experience in the community ($\bar{x}$ = 3.5 years).

Data collection

The data were collected through participant-observers and semi-structured interviews. Our cultural immersion in the Pikogan and Lac Simon communities took place over 2 months in March and April 2006, during which time we observed the activities of health workers; participated in collective kitchen activities, community meals, home visits, etc.; and made observations on the environment, for example, the food in the convenience store and the school canteen ("Club des petits déjeuners"). We used a logbook to record our observations in a condensed, consistent format to encourage reflection, as recommended by the *Observation-Participation-Reflection Enabler*.[8] We interviewed key informants in French, usually at the community health centre, using semi-structured interviews based on Leininger's cultural factors[8,9] and the Taylor et al. study.[14] (see Appendix A). The interviews, which lasted on average

TABLE 1
Summary of the sociodemographic and health profiles of the key informants (n = 7)

Fictitious name[a]	Community	Language spoken			Time of GD diagnosis	Diagnosed with T2D	BMI, kg/m^2	Number of children
		Algonquin	French	English				
Amy	Lac Simon	Yes	Yes	No	1999	Yes	36.0	6
Brenda	Lac Simon	No	Yes	No	2003	Yes	28.3	6
Céline	Lac Simon	No	Yes	No	2004	No	36.0	5
Diane	Lac Simon	Yes	Yes	No	2003	No	34.4	4
Isabelle	Pikogan	No	Yes	Yes	2003	No	33.9	4
Julie	Pikogan	No	Yes	Yes	2003	No	36.6	5
Kimberly	Pikogan	No	Yes	No	2003	No	28.9	5

Abbreviations: BMI, body mass index; GD, gestational diabetes; T2D, Type 2 diabetes.

[a] A fictitious given name (similar to those found in the two communities) was assigned to the key informants according to the order of the interviews. Thus, the first person interviewed at Lac Simon was assigned the letter A and a given name starting with the letter *a* and so on until D. To differentiate the women of Pikogan, the fictitious names began with the letter I and continued until the letter K.

* The directors of both community health centres agreed to the communities being named in this article.

for 47 minutes, were recorded to allow subsequent verbatim transcription and analysis.

The focus of the interviews was on maintaining health behaviours and not on obstacles to maintaining them. This study was not intended to influence or judge existing health behaviours.

Data analysis

We analyzed our observations in four phases[10] and followed Miles and Huberman's process of data analysis.[20] The first phase was based on our observations during the cultural immersion and the interviews with the Algonquin women. The log book entries helped to place the verbatim interviews in context. In the second phase, we conducted a vertical analysis of the verbatim interviews, classifying each sentence according to Leininger's cultural factors,[8,9] in order to reveal the cultural factors within each transcript. The third phase, the horizontal analysis of patterns and context of the cultural factors, resulted in a collection of those cultural factors that contributed to the maintenance of the health behaviours encouraged during the pregnancies of all the interviewees. During the fourth phase, we confirmed the themes and subthemes with the key and general informants. Only one theme was reconstructed after this confirmation: it concerned the importance of friends in the maintenance of health behaviours.

Appendix B lists the strategies used to ensure rigorous data analysis.

Ethical considerations

The ethics board of the clinical research centre of the Centre hospitalier universitaire de Sherbrooke and the directors of the Pikogan and Lac Simon health centres approved this study. It followed the guidelines set by the Tri-Council Policy Statement[21] for research projects conducted on lands under the jurisdiction of a First Nations authority, including obtaining written approval from the responsible community bodies and masking the identities of participants.

Results and discussion

Table 2 summarizes the main cultural factors that contributed to the maintenance of health behaviours, arranged according to five themes and several subthemes. The results are presented and discussed in the same section.

Family and social ties as motivation and support for maintaining health behaviours

Family and social ties were the primary motivation for maintaining health behaviours. As found by Taylor et al.,[14] the Algonquin women participating in this study did not want their children to develop diabetes: "Yes, I kept eating the same way. I did it mainly for myself and my daughter. I don't want her to have adolescent diabetes either. She's overweight, and I don't want that for her. So I kept my way of eating... but more for myself... and her too" (Julie[1], line 528).

The experiences of key informants' parents was a constant reminder of the possible complications: "I can't allow myself to have complications like that in just five years... My father was on dialysis, and my grandmother had to have an amputation" (Amy, line 45).

The encouragement of family and the community was important: "Everyone tells me they can see I am losing weight. It helps when someone tells you that" (Julie, line 840). Also important was offering support: "... We tried to come up with a kind of diet that we could go on, her and me, to help our diabetes" (Julie, line 359). Another way of encouraging was by giving advice: "[My sister] told me: 'That has too much sugar in it... That's what's in there. How many calories are in a meal if you go to a restaurant?' Because my sister is diabetic. That really helped me too" (Kimberly, line 378).

The communities supported some physical activities, mainly walking, by painting these in a positive light: "I think people

TABLE 2
Factors promoting the maintenance of health behaviours in the key informants (n = 7)

Factors	Theme	Subthemes
Family and social	Family and social factors as motivation and support for the maintenance of health behaviours	Concern for children's health
		Family and community support
		Family members' experiences
		Desire to be together
Lifestyle and cultural	Adopting new health behaviours while preserving cultural values	Adaptation of traditional foods
		Diet modification
		Walking
		Synergy between diet and walking
Educational	Learning through educational resources adapted to needs and culture	Capacity for self-learning
		Cultural adaptation of teaching and support
Economic	Saving money through better diet	
Technological	Access to blood sugar data through technological advances with glucometers	Glucometers as a means of immediately checking whether blood sugar is normal
		Downloading eliminates the need to write the information down

[1] When doing so did not affect the phenomena under study, we deleted or changed certain facts to preserve the anonymity of the key informants.

are starting to see the value of it ..." (Kimberly, line 939). Walking lets people socialize as they engage in a physical activity: "I go walking with a friend. We talk and chat while we walk... sometimes I go with my boyfriend" (Kimberly, line 947).

Family or social support was very important to the participants, and lack of it makes it more difficult for some First Nations women with diabetes to effectively adopt new health behaviours.[12] From a psychosocial standpoint, individuals who receive peer support run less of a risk of developing physical or mental problems.[22]

Adopting new health behaviours while preserving cultural values

The second theme consists of adopting new health behaviours, especially those related to diet and physical activity, while preserving cultural values.

According to the Algonquin women, their traditional diet can be adapted to help maintain health behaviours. The methods of cooking certain traditional foods and using less fat in food preparation can contribute to good health and prevent diabetes. The key informants said they could choose game meats that have less fat than others (e.g. moose versus beaver).

The key informants changed their diets following a GD diagnosis and followed a balanced diet that reflected the goals of Canada's Food Guide.[23] The changes consisted of additions to traditional foods, not their removal. Due to their symbolic aspect, the use of traditional foods and methods of preparation are important to First Nations peoples, and they feel accepted and respected when health care professionals take these traditional practices into account.[24]

The key informants said that they would like a cookbook that included traditional foods to help them manage their diabetes; this would also uphold respect for traditional values. Both health centres held community meals that included traditional foods adapted for a special diet, for example, *banik* (traditional bread) prepared with whole-wheat flour, and also distributed the recipes.

The participants also considered exercise key to maintaining a healthy weight and preventing type 2 diabetes: "Exercise is the important thing for me because when you train a lot, diet follows. I know that when I was walking a lot, I was less likely to eat chips and drink soft drinks" (Kimberly, line 881). Walking was the physical activity that was mentioned most often during the interviews because of its numerous advantages, not least that it both energizes and relaxes: "Walking? Yes, it helps me a lot with stress because I work and I have five children at home under the age of 10" (Julie, line 746). Walking can also be compatible with family values (e.g. walking with the children) and the participants' lifestyles (e.g. not having a car, working outside the home).

The significance of weight loss as described by the participants is supported by research that shows that overweight and lack of physical activity are risk factors for type 2 diabetes,[2] and that a 5% to 10% weight loss through changes in diet and physical activity can prevent or delay the emergence of type 2 diabetes in certain persons with glucose intolerance.[25] Critical to this was the participants' perception of thinness and overweight. Although each had a high body mass index (BMI $\bar{x}$ = 33.4), they did not associate slenderness with disease, unlike people in other studies.[13] Rather, they had a negative perception of overweight, as did the women of the Oklahoma First Nations.[14]

Learning new behaviours through educational resources adapted to needs and culture

According to the key informants, certain ways of acquiring new knowledge provide more choices and freedom: the third theme addresses the opportunity of learning with educational resources adapted to needs and culture. For example, self-learning through reading helps prevent frequent visits to the health centre and provides a certain form of autonomy where there is an overall lack of other resources: "... usually it meant I didn't have to go anywhere... because... since there are no training sessions on that here, and often there was a long wait to see the nurse" (Céline, line 1168). The capacity for self-learning and keeping informed increases the chances of staying healthy: "Are there things you do to be able to say 'that's important for me for staying healthy'?" (Sylvie, line 1183, interviewing Isabelle). "Yes, keeping informed, that's all!" (Isabelle, line 1187). Daniel and Messer[26] also found that First Nations place considerable value on autonomy and may even be wary of health education initiatives they perceive as an occidental intrusion into their way of life. This preference for autonomy is supported by the shared decision-making framework,[27] which could be more acceptable to them than regular diabetes classes.

The Algonquin women who participated in this study mentioned the importance of learning with educational resources and supports adapted to their needs and culture, especially to their way of life. For example, they wanted to learn how to choose ingredients to preserve or improve nutritional values in their traditional foods. "I made *banik* at home using vegetable oil. I wanted to change oils, but I didn't know which one to choose...the one with the lowest fat (the least unhealthy one)" (Julie, line 618). They also wanted to learn ways that uphold the traditional Algonquin way of life, which involves frequently being in the woods: "What we eat, the Anicinabek [Algonquins]... [laughter]... we often go out in the woods as well... They should think about that...we go out in the woods" (Brenda, line 855).

This cultural adaptation of learning can also take place through other adapted activities. Several key informants mentioned the idea of a forest "diabetes camp" co-facilitated by the nurse and the nutritionist who would incorporate instruction into traditional activities (e.g. walking in the woods, snowshoeing). Macaulay et al.[28] also understood the importance of adapting instruction to Mohawk culture to positively affect diabetes prevention.

According to the key informants, the continual illness prevention and health promotion activities of health care professionals were key to maintaining health behaviours. The health care professionals would frequently encourage those making progress with respect to their health, especially people living with

diabetes of any type. They took advantage of community events to hold their health promotion activities. They adapted appointments to the Algonquin way of life: instead of making appointments for a fixed time and date, they intervened immediately, adapting to a culture-specific concept of time described by the general informants as "now or never."

Some general informants maintained that, compared to previous generations, the younger generation of Algonquin women are more likely to make individual life choices. Further, if they feel good in their everyday lives, they tend to "shop well" and buy healthy, nutritionally balanced foods. Some key informants said they felt more comfortable with the First Nations nurse who questioned them regularly about drug and alcohol use, the support given by their family, etc. This holistic approach was in line with the values of the women in both communities.

Even though previous studies found that educational activities are not always adapted to First Nations culture, according to the key informants the health care professionals facilitated the adoption of health behaviours and organized a number of activities that were culturally adapted to Algonquin women, as recommended by Daniel and Messer.[26]

Saving money through better diet

After learning how to manage their diabetes, a number of participants found themselves saving money by eating a better diet. Some said they went to restaurants less often or ate differently when they did go out to eat: "I didn't eat out as often. It became less expensive to eat out because I cut down on my portions" (Isabelle, line 1062). They maintained the health behaviours after pregnancy because of the money-saving aspect of the better diet.

During their pregnancy, some of the participants took part in community kitchens funded by the Canada Prenatal Nutrition Program.[29] They learned about the costs of different foods as well as how to read flyers and make shopping lists: "I often looked at the flyers... I went to the places where there were better specials" (Céline, line 1110). They said that as a result they could make more informed choices about the quality and quantity of foods, and that this affected their budget.

Access to information on blood sugar using glucometers

The final theme concerns access to blood sugar monitoring through technology. Several participants in both communities used a glucometer to measure their blood sugar levels: "It shows whether...your blood is normal and all that!... You see right away whether your blood is normal" (Céline, line 182). Some of the participants who did not currently have diabetes continued to use their glucometers regularly to monitor their blood sugar as a preventive means.

Technology available to the Algonquin women in both community health centres allows them to monitor and compare their blood sugar levels more easily by downloading the glucometer data in a graphic so that they do not have to record their blood sugar levels. Self-monitoring can reduce the use of clinical and professional care, and users feel more self-confident and independent, both important elements in self-management.[30]

Limitations of the study

This study sheds light on cultural factors that contribute to the maintenance of health behaviours in a First Nation population. This perspective is primarily that of the Algonquin women who received educational services and support for GD during their pregnancy and post-partum. General informants of both Algonquin and non-Algonquin origin supported the themes that emerged from the data. As a result of basing this study in the two communities of Lac Simon and Pikogan, we have taken into account about one-quarter of the Algonquin population in Quebec,[31] though not necessarily those living in urban communities.

Conclusions

While this study is exploratory in nature, it suggests that cultural practices can influence the maintenance of health behaviours among Algonquin women who have had GD.

Our study found that an approach centred on friends and family rather than on the individual could help Algonquin women who have had GD maintain healthy behaviours. Cultural adaptations of health education were a priority in the maintenance of health behaviours for the study participants. Health care professionals could continue to develop activities for Algonquin women that are culturally adapted, such as those in the woods or in environments conducive to physical activity. Working closely with their clients, health care professionals can help them make full use of their own abilities to become autonomous and improve their well-being.[32] In addition, Health Canada has published a new Canada's Food Guide, including one specifically for First Nations, Inuit and Métis.[33] The adapted version could be used to explain the nutritional, social and spiritual value of traditional foods and to explain the harmful effects of processed foods as part of a strategy to reduce obesity and obesity-related chronic disease such as diabetes.[33] The Algonquin women in the study also found that they were able to save money through a more nutritious diet.

Our study found that using a glucometer to measure blood sugar levels seemed to empower participants, indicating that it could be used as a tool in preventive self-management practices. This is at variance with the 2009 recommendations on glucometer use made by the Canadian Agency for Drugs and Technologies in Health (CADTH).[34] In its review the CADTH did not notice significant clinical improvement of the A1C concentrations in non-insulin-dependent patients.[34]

The themes emerging from this study present a unique cultural perspective that could help health care professionals and First Nation communities develop services and strategies specifically for Algonquin women who have had a GD diagnosis. These services and strategies could contribute to the health and well-being of pregnant women and their children and in the prevention of type 2 diabetes in the Algonquin population.

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Appendices

APPENDIX A
Interview guide (based on Taylor et al.[14], p.9)

World view
• Describe your current health.
• Describe how you feel about your health.
• What do you do to stay healthy?
• Do you have any health concerns?
• What are the major health concerns of Aboriginal women?
• What comes to mind when I say "gestational diabetes"?
• What do you think happens to a woman once she develops gestational diabetes?
• And after her pregnancy?
• What do you think happens to the baby of a woman who develops gestational diabetes?
• And after his or her birth?
• What does a woman in your community do if she is diagnosed with gestational diabetes?
• In your community, how do people explain gestational diabetes?
• Do you think that gestational diabetes is more or less frequent in your community?
• How does your community care for a woman who is diagnosed with gestational diabetes?
Language
• What are the words used to speak about diabetes?
• What are the words health care professionals use to speak about diabetes?
Technological factors
• How did you monitor the sugar in your blood when you were pregnant?
• Are there technological tools that help manage gestational diabetes?
Religious and philosophical factors
• Did you consult with a wise man or a shaman when you had gestational diabetes? Explain.
• What treatments do you trust to treat gestational diabetes?
Social and family factors
• What is the role of members of your family regarding gestational diabetes?
• How would you make decisions regarding gestational diabetes in your family? In your community?
Cultural values and way of life
• What do you think causes gestational diabetes?
• Why do you think these things (mentioned above) cause gestational diabetes?
• How did you react when you received the diagnosis of gestational diabetes?
• Which changes did you make during your pregnancy after you learned of the diagnosis of gestational diabetes?
• Which changes didn't you make among those that were recommended?
• What did you maintain in the changes you made while pregnant?
• What is your main concern about having gestational diabetes?
• In your view what is good nutrition or a balanced diet?
• In your community what do you consider to be traditional foods? Are they part of the regular diet of your community?
• Do you think eating a more traditional diet would help prevent diabetes or gestational diabetes?
• Which foods should a woman with gestational diabetes eat?
• In your community can a woman with gestational diabetes exercise?

Continued on the following page

APPENDIX A (continued)
Interview guide (based on Taylor et al.[14], p.9)

Political and legal factors
• How does the community show its concern for women who have gestational diabetes?
• What do you think the Band Council or the government could do to help women that have gestational diabetes?
Economic factors
• What are the main expenses caused by having gestational diabetes?
• Did those expenses have a repercussion on your budget?
Educational factors
• How did you learn what you know about gestational diabetes?
• Where do you find your information about diabetes?
• To what extent are you satisfied with the information you received on gestational diabetes? How was this information adapted to your culture?
Care practices
• What are the most important behaviours to maintain your health?
• How did you come to associate health with these behaviours?
• In your opinion, are those behaviours also important for your children?
• What are the health behaviours that you would like to pass on to your children?
• How do you try to pass on those health behaviours to your children?
• Do you think these behaviours have an impact on diabetes or gestational diabetes?
• If yes, what kind of impact?
• If not, which health behaviours could have an impact?
• What could a woman who has/had gestational diabetes do to try to prevent or to delay onset of diabetes?

APPENDIX B
Strategies used to ensure rigour in analysis of data

Criteria	Definition[17]	Strategies
Credibility	Accuracy, truthfulness and authenticity of results	Verbatim transcript Sentence by sentence analysis Inter-rater agreement
Confirmability	Approval of results by informants	Results submitted to informants and modification of a theme
Meaning in context	Meaning given to results reveals one of people from a specific context	Rich and dense description of the context, supported by notes in the logbook
Recurrent patterning	Detailed examination of data to discover the repetitions of themes, patterns, behaviour reflecting a trend	Horizontal analysis Inter-rater agreement
Saturation	Results answer the goal of the research and additional data won't help in the understanding of the phenomenon	Confirmation by informants that the phenomenon was adequately covered
Transferability	Application of results to other contexts, situations or cultures	Conference given to the Rapid Lake Presentation to First Nations and Inuit Health, Quebec Region Rich and dense description of the context Publication of an article in a scientific journal

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Coaches' knowledge and awareness of spit tobacco use among youth athletes: results of a 2009 Ontario survey

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Abstract

Introduction: Public health professionals have become concerned that spit tobacco (ST) use among athletes is increasing. However, little is known about the issue in Canada, particularly among youth.

Methods: The Not to Kids Coalition and the Coaches Association of Ontario surveyed coaches regarding ST knowledge and awareness and their perceived roles as coaches in influencing ST use among their athletes. Surveys were distributed electronically to individuals who coached male and female youth aged 9 to 18 years in baseball, basketball, football, soccer, and track and field, in Ontario.

Results: Almost all of the surveyed coaches responded correctly to questions about the health effects of ST use, and about 80% of respondents answered correctly to the question about legislation associated with ST and youth.

Conclusion: Most coaches are interested in receiving information about ST, particularly the health effects of ST use and how to prevent ST use among athletes. Multiple formats should be used to provide information to coaches, including both electronic and hard copy materials.

Keywords: tobacco, smokeless chewing tobacco, youth, sport, mentor, coach

Introduction

Anecdotal observations and local survey results shared at Not to Kids Coalition (NTK) meetings between 2006 and 2007 have indicated that the use of oral (spit) tobacco is increasing among sports participants.[1] The purpose of our research is to assess the knowledge level of Ontario coaches about spit tobacco (ST) products and to assess their perceptions of ST use among the athletes they coach. This study is not intended to measure prevalence; it was undertaken to direct health promotion initiatives that prevent initiation and promote cessation of the use of ST products among youth. The study was completed through an online survey of amateur coaches who work with children and youth in Ontario.

This project directly addresses legislation mandated by the Ontario government: to work with priority populations to adopt tobacco-free living and reduce the burden of preventable chronic diseases. It also addresses the requirement of Boards of Health to monitor emerging trends in tobacco use.[2]

Background

Spit tobacco: use and risks

Smokeless tobacco is defined as tobacco products that are administered without being burned.[3] Smokeless tobacco is mainly found in two forms: oral (moist) snuff, which is powdered, and chewing tobacco, which is coarsely cut.[4] Those who use smokeless tobacco either place a "pinch" of snuff between their gum and their lip or cheek or chew a "wad" of chewing tobacco. The released nicotine is absorbed through membranes in the mouth.[4] The term spit tobacco (ST) is used here to refer to both these forms of tobacco.

Like all tobacco products, ST is associated with many adverse health outcomes. Tobacco-specific nitrosamines (cancer-causing chemicals) have been linked to oral cancers in humans.[5] Specifically, ST use has been shown to cause leukoplakia, white patches and lesions on the cheeks, gums or tongue that may lead to oral cancer.[5] ST use can also lead to gum disease and tooth decay and is associated with increased mortality from cardiovascular disease and stroke.[6,7] Of particular concern is that ST may be more addictive than cigarettes; compared to cigarette smokers, ST users are exposed to large amounts of nicotine over longer periods.[5]

Use of spit tobacco among youth

The NTK is a network of 31 public health units from across Ontario whose aim is to reduce youth access to and use of tobacco

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products. NTK recently conducted surveys and focus groups among Ontario youth aged 14 to 19 years. These indicated that youth perceive ST as a safer alternative to cigarette smoking because it produces no smoke.[1] Moreover, youth respondents failed to identify many of the health-related consequences of using ST.[1]

In North America and Europe, ST use is not as prevalent as cigarette smoking, but it may be increasing due to the introduction of smoking bans in public spaces.[7] According to the 2008 Canadian Tobacco Use Monitoring Survey, 1% of youth aged 15 to 19 years (n = 30 000) and 1% of young adults aged 20 to 24 years (n = 27 000) reported using ST in the preceding 30 days.[8] However, in the 2008/2009 Youth Smoking Survey, 5% of Canadian youth in grades 6 through 12 (n = 2 600) and 4% of Ontario students in grades 6 through 12 (n = 360) reported having "ever tried" ST.[9]

In the United States, the National Survey on Drug Use and Health reported that ST use among persons aged 12 or older remained stable at between 3.0% and 3.3% from 2002 to 2007.[10] However, ST use increased among certain subpopulations, specifically adolescent males, from 3.4% in 2002 to 4.4% in 2007, and was higher among those residing in rural areas.[10]

Age, gender, geography, ethnicity and education are all factors related to the prevalence of ST use. The 2009 National Youth Risk Behavior Survey estimated the prevalence of ST use among American high school students at 8.9%.[11] This prevalence varied across states, ranging from 4.9% in Hawaii to 16.2% in Wyoming, and was higher among male compared to female high school students and among White compared to Black and Hispanic students.[11] The prevalence among White male students was very high, at 20.1%.[11]

Goebel et al. identified several correlates to ST use among fifth, eighth and eleventh graders in the United States, including having a family member not living at home who uses ST, having a friend who uses ST, playing football, trying cigarettes in the past, and having parents that permit ST use at home.[12]

Use of spit tobacco in sport

To determine how ST use varies across sports, a 2001 National Collegiate Athletic Association (NCAA) study asked male athletes (17–20 years) to report their ST use in the preceding 30 days. ST use was reported as follows: baseball, 41%; wrestling, 39%; ice hockey, 35%; lacrosse, 32%; football, 29%; golf, 27%; water polo, 25%; soccer, 20%; track and field, 17%; tennis, 13%; and basketball, 12%.[13]

Research indicates that adolescents who participate in organized sports, while less likely to smoke cigarettes, are more likely to use ST.[14,15] Castrucci et al. reported that adolescents in grades 9 through 12 who participate in organized sports have 33% increased odds of ever using ST and 76% increased odds of currently using ST.[14] Rigotti et al. reported similar findings in their study of 14 138 students aged 18 to 24 years at 119 colleges in the United States.[16] The researchers found that intercollegiate athletes were more likely to use ST than cigarettes and suggested that athletes may be using ST instead of cigarettes as a substitute form of nicotine.[16]

The NCAA conducted a study of 1985 teams through 1032 member institutions that produced 19 676 responses; they found the prevalence of ST use to be 16.3%.[17] Among athletes who use ST, more than 50% began in high school; however, approximately 10% began using ST in junior high school or earlier.[17]

College student-athletes reported using recreational drugs, such as ST, primarily for recreational or social reasons (46.8%) or "to feel good" (28.1%).[18] Other reasons given included to help deal with the stress of college life and college athletics (21.2%), to improve athletic performance (2.0%) and to fit in with the team (1.8%).[17]

The role of coaches

Coaches play the role of teacher, mentor, role model, friend and leader in the community.[19] They have a strong influence over team values and norms and, as role models, can have a marked effect on shaping the habits of children and young adults.[20]

Walsh et al. confirmed coaches' influence on athletes, specifically in regard to ST use.[21] Their findings indicate that male high school baseball players were three to four times more likely to use ST if they saw their high school coach or father using ST.[21]

Coaches have the ability to encourage uptake as well as to discourage ST use. They are key players in the effort to decrease ST use among athletes because of their access to players at different stages of ST use (e.g. initiation, experimentation, regular use).[22] Of the coaches surveyed by Horn et al., 80% agree that they play vital roles in preventing ST use among athletes, while 86% believe they could assist youth with ST cessation.[22] Coaches report using several strategies to address ST use among their athletes, including advising athletes to quit, informing athletes about the health hazards of ST use, and informing athletes' parents or school principals.[22]

Methods

NTK partnered with the Coaches Association of Ontario (CAO), a non-profit coach-led organization that provides development opportunities and educational resources for coaches, to develop and electronically distribute a survey to amateur coaches in June 2009. The purpose of the survey was (1) to assess coaches' general knowledge and awareness of ST use and (2) to better understand coaches' perceptions of their roles in influencing and preventing ST use among their athletes.

All of the coaches surveyed were members of amateur sport organizations. As such, it is assumed that they were unpaid volunteers at all levels of all sports and coached their athletes on their own time.

Members of CAO and NTK and an epidemiologist decided on the criteria for participating in the survey and developed the survey through an iterative process of identifying content and refining questions. Eligibility criteria, including the rationale for inclusion and exclusion of coaches, were as follows:

- Participants were at least 18 years of age. Anyone younger than 18 would have required more extensive consent procedures.

- Participants coached at least one of the following: hockey, baseball, soccer, basketball, football, or track and field. CAO, the primary vehicle for initial data collection, only included coaches of these sports in their membership.
- Participants coached youth aged between 9 and 18 years. A broad age group was chosen as little research has been conducted regarding ST among youth athletes, and none to date has included youth aged less than 12 years.

The surveys were distributed electronically using SurveyMonkey, an Internet-based survey development tool. Responses were encrypted and housed on the SurveyMonkey web server.

CAO members who met the eligibility criteria were the initial target population. The sample size estimate of 321 was determined based on the CAO membership size and given a margin of error of 5% and a confidence interval of 95% (Table 1).

CAO informed their members about the project and supplied the survey link in their monthly e-newsletter on June 11, 2009. Respondents were offered the opportunity to win one of four $50 gift certificates or various anti-tobacco promotional items as an incentive to participate, the winners being selected by a random draw following the survey end date.

Two weeks after the initial e-newsletter distribution by CAO, there were 79 completed surveys. A reminder about the survey was included in the July e-newsletter to CAO members. Following this communication, the survey completion rate remained poor. As a result, the survey link was also distributed to the provincial governing bodies of the targeted sports: Ontario Baseball Association, Ontario Basketball Association, Ontario Football Alliance, Ontario Hockey Federation, Ontario Soccer Association and Athletics Ontario. CAO formally requested that these organizations distribute the link to their members in their own e-newsletters. One month after the initial communication, there were 270 completed surveys. The survey link was then made available to NTK members to distribute among their local sport organizations to increase the number of responses. In broadening the population, statistical significance could no longer be computed. However, statistical significance would not have been attained based on the survey completion rate by CAO members alone due to the small sample size. It was also recognized that in changing the data collection strategy the population might carry an inherent geographical bias (e.g. different health regions may advocate more strongly than others); however, this also was offset by the need to increase the number of survey respondents.

A descriptive analysis including frequencies and cross-tabulations was completed using SurveyMonkey and Microsoft Excel 2000.

TABLE 1
CAO members participating in a survey of spit tobacco use among youth athletes

Sport	Coaches, n	
	Population in CAO	Sample size required for subgroup analysis[a]
Baseball	124	94
Basketball	969	276
Football	119	92
Hockey	244	150
Soccer	353	185
Track and field	113	88
Total	1922	321

Abbreviation: CAO, Coaches Association of Ontario.

[a] Sample size estimate based on a margin of error of 5% and a confidence interval of 95%.

Results

There were 344 completed surveys on the SurveyMonkey web server. Of these, 83 were excluded because the respondents did not meet the eligibility criteria (coached a sport other than sports of interest, n = 70; coach reported only coaching athletes aged 8 years or less, n = 9, or 19 years or older, n = 4). The remaining 261 survey responses were analysed using descriptive statistics.

Coaches

Of those surveyed, the majority of coaches (72%) were aged between 35 and 54 years, approximately 10% were aged 55 years plus and the remaining 20% were aged between 18 and 24 years. In addition, most were male (76%).

Geography

Table 2 shows the geographic distribution of coaches. Geographic regions are based on Tobacco Control Area Networks (TCANs), created by the Ministry of Health Promotion and Sport under the Smoke-Free Ontario Strategy in order to coordinate regional initiatives, facilitate use of limited resources and tailor activities to suit specific contexts.[13]

TABLE 2
Geographic distribution of surveyed coaches, Ontario, Canada

TCAN region	Proportion, %
Central East	29
Central West	34
Eastern	9
North East	5
North West	1
South West	13
Toronto	9
Unknown	2

Abbreviation: TCAN, Tobacco Control Area Networks.

Sport

The distribution of coaches by sport was uneven. Over a quarter (29%) of respondents indicated they primarily coach baseball, and about the same proportion (28%) reported that they mainly coach soccer. Basketball coaches (17%) and hockey coaches (13%) were also well represented. Football and track and field coaches each represented less than 10% of the sample respectively.

Level of competition

Most coaches reported coaching athletes at more than one level of competition, with the majority coaching at the competitive (provincial) level (59%) and/or recreational level (43%).

Frequency and duration of coaching

Coaches at all levels of competition reported coaching two or more months out of the year. One-third (32%) reported coaching their team for three to five years; however, 18% had been coaching for as little as less than one year, and 26% for as long as six or more years.

Athletes

Most coaches reported coaching athletes in many age categories. Overall, the largest proportion were aged 13 to 14 years. Just over half of the coaches (51%) reported coaching all-male teams, though the sample also represented coaches of all-female teams (31%) and of mixed teams (26%).

Self perceived knowledge about ST

Most coaches (68%) reported knowing at least something about ST. More of the coaches aged 45 years plus had at least some knowledge of ST compared to coaches aged less than 45 years, 74% versus 58%.

Method of obtaining ST products

Many coaches (29%) believe athletes purchase ST products directly from vendors, for example, convenience stores, while the same proportion believe athletes are given ST products by friends, family and/or acquaintances. Some coaches (15%) believe athletes obtain ST through the "grey market" (e.g. Internet, street sales), 6% believe ST is taken from home without permission, 3% selected "Other," and 18% believe that athletes are not obtaining ST products.

Perceived prevalence of spit tobacco use among athletes

The majority of coaches (78%) reported that none of the players on their teams used ST. Approximately 9% reported that they have either witnessed their players using ST or they suspect that one or more players use ST, while 5% reported that they have witnessed players on other teams using ST. Ten per cent of respondents reported they do not know if any of their players use ST.

Only those coaching athletes aged 13 years plus reported ST use on their teams. However, a few coaches of athletes aged between 9 and 12 years indicated that they suspect ST use or they had witnessed ST use among athletes in the same age range on other teams.

All coaches who reported *seeing* one or more of their players using ST coached all-male teams. Only coaches of baseball, football and hockey reported witnessing athletes on their teams using ST.

Knowledge about ST products and use

The "True or False" section of the survey questioned coaches on their knowledge of ST products and use. The majority of coaches (98%) indicated correctly that ST does not enhance athletic performance; that ST is not a safe alternative to smoking (98%); and that ST may cause mouth sores, gum recession and/or tooth loss (98%). Of the respondents, 96% indicated correctly that ST use might contribute to high blood pressure, heart attacks and strokes, 52% agreed that "spit tobacco is a growing problem among youth practicing sports in Ontario these days," and 78% indicated correctly that it is illegal to give ST to youth younger than 19 years.

Perceived role in addressing ST use

Coaches were asked what they thought their role was with respect to addressing ST issues on their team. Over half indicated they would meet with and counsel their athletes (56%) and/or inform the athlete's parents (54%). Providing athletes with written information on ST was also a popular choice (38%). Some also reported referring athletes to support services (e.g. health care providers, public health professionals, sport officials) and/or informing the league organizer or other community agencies (e.g. leagues, schools) of any ST use (36% and 25%, respectively).

Strategies used to address ST use

Almost half of respondents (45%) reported they have not done anything to influence their athletes regarding ST use and that they have not addressed ST use on their teams because they do not consider it to be an issue. Several, particularly coaches of female athletes, said they did not see a need to address ST use as their athletes were too young. Approximately one-quarter (23%) indicated that they promote and/or enforce a tobacco-free sports policy.

Useful ST information for coaches

Coaches were asked to select the types of information that would be most helpful in advising youth about ST use. Almost half (47%) indicated that information about the health effects of ST would be the most helpful (Table 3).

Preferred means of receiving information on ST

Many coaches indicated they would prefer to receive information about ST via the CAO website (40%), in their coaching manuals, or in newsletters and pamphlets (Table 4). Since many of the survey respondents were CAO members and had likely accessed the survey through the CAO website, the preference for this format as a way to receive further information may not be true for the larger coaching population. A small proportion of respondents indicated they would prefer to attend workshops to

TABLE 3
Types of information on spit tobacco that would be useful to coaches, by TCAN region, Ontario, Canada

Type of information deemed useful	Coaches by TCAN region, %							
	Central East	Central West	Eastern	North East	North West	South West	Toronto	All regions
Different forms of ST	29	22	25	13	0	29	34	**26**
Health effects of ST	46	46	50	40	67	50	59	**47**
How to encourage athletes to stay ST-free	36	35	25	47	0	38	48	**36**
How the tobacco industry targets youth	28	21	43	20	0	31	31	**27**
I do not require information at this time	24	31	21	27	33	26	7	**25**

Abbreviations: TCAN, Tobacco Control Area Networks; ST, spit tobacco.

TABLE 4
Coaches' preferred sources of information on spit tobacco, by TCAN region, Ontario, Canada

Preferred source of information	Coaches by TCAN region, %							
	Central East	Central West	Eastern	North East	North West	South West	Toronto	All regions
CAO website	45	35	54	47	0	29	55	**40**
Health Unit website	34	21	18	13	33	24	21	**24**
Workshops	5	3	7	7	0	2	3	**4**
Newsletters and pamphlets	31	37	46	7	0	38	34	**34**
Coaches' manual	45	32	29	27	67	43	31	**36**

Abbreviations: CAO, Coaches Association of Ontario; TCAN, Tobacco Control Area Networks.

learn about the topic. In the "Other" category, most responses indicated email (from their sport club or the CAO) as their preferred format to receive information.

Discussion

Our aim was to find out about coaches' knowledge of ST use among their athletes and their knowledge gaps with respect to ST use.

The majority of respondents reported they have not witnessed any ST use among athletes. Since this study was intended to direct health promotion activities rather than provide a prevalence estimate, the results of this investigation are not comparable with previous studies of self-reported ST use among athletes.[13,17] Additional factors associated with differences in the study populations (e.g. age, geography and culture) may further distort comparisons with previous ST prevalence studies. However, our finding that only coaches of all-male teams observed ST use among their athletes is consistent with findings from other studies.

Many coaches report they have not done anything to address the issue of ST on their teams. However, rather than this being as a result of a lack of interest in their athletes, most coaches do not see the need to address ST use because they do not regard it as an issue on their teams. It is possible that this study demonstrates that coaches are not well aware of ST use among their athletes.

Coaches aged 45 years plus are more confident about their knowledge of ST products and use compared to younger coaches. In addition to their age, certain characteristics of coaches and athletes are important to consider since they relate to findings about coaches' knowledge and awareness of ST. For instance, results from this study are mostly applicable to all-male baseball, basketball, soccer and hockey teams.

While many coaches report that ST use is not a problem on their teams, almost three-quarters of the coaches said they would like more information on the topic. The results of the study provide insight into techniques that coaches currently use to address ST use among their players.

Strengths and limitations

The survey link was initially distributed only to coaches who were active members of CAO. As data collection progressed and it became apparent that sample size targets would not be met, the sampling strategy was amended. The survey link was distributed to a much broader population and distribution was not uniform across the province. As a result, there may be clustering among survey respondents, causing some responses to be more similar than would be expected if it were a random sample. Given the broad distribution and not knowing who received the survey, the results may not be generalizable to the larger population of coaches.

Out of 36 public health units in Ontario, 31 are members of NTK. As a result, and because of different strategies for promoting the survey to coaches by member health units, all areas in Ontario were not equally represented. Thus, the results of this survey may not be generalizable, particularly for underrepresented geographical areas.

Since the sampling strategy changed during data collection, it is not possible to estimate a response rate. However, considering the response rate among CAO members was extremely low at the outset, electronic distribution of surveys might not be the most effective data collection strategy for this population. Another limitation associated with online surveys is the potential for bias among respondents. For example, a large proportion of respondents selected the CAO website as their preferred format to receive information; however, respondents who complete online surveys are likely to be more familiar with the virtual environment relative to the larger population of coaches.

Web-based survey programs have the inherent limitation of some degree of data insecurity. No identifying or personal information was collected in this study and all data was encrypted.

Despite the limitations of electronic survey distribution, this data collection method is efficient and inexpensive, making it well suited for a study involving a large sample of geographically dispersed respondents such as this one. Another advantage of online surveys is that there are clear start and end dates and results may be analyzed as soon as the data collection period ends.

Despite its limitations, this study is one of the first in Canada to shed light on an important and emerging issue.

Conclusion

Based on the survey results, coaches are fairly knowledgeable about the effects of ST products and ST use: almost 100% of coaches responded correctly to questions about the health effects of ST use, and about 80% of respondents correctly answered the question about legislation associated with ST and youth.

Most coaches are interested in receiving information about ST, particularly the health effects of ST use and how to prevent ST use among athletes. Multiple formats should be used to disseminate information to coaches. Both electronic (CAO website, emails from sport organizations, Health Unit website, etc.) and hard copy (included in coaching manuals, newsletters, pamphlets, etc.) formats were indicated as preferred methods to receive information about ST.

Our findings may be used to increase coaches' knowledge of ST use and ST effects in order to increase their ability to influence the tobacco use habits of their players. Coaches should learn more about ST products and their use, particularly as ST use is a growing issue in sport.

By better understanding coaches' perceptions of ST use and their information needs, public health professionals can develop initiatives that encourage coaches to take a more active role in ST prevention. These initiatives could include information and tools tailored to coaches' needs.

Since TCANs develop regional tobacco control plans and coordinate activities among member public health units,[24] the results from this study may be used to direct TCAN health promotion and tobacco prevention activities as well as those of provincial groups, such as NTK.

Public health professionals in Ontario are currently focusing on tobacco-free sport and recreation (TFSR) policy as the next step in population-based tobacco control. Results from this study support the TFSR movement by adding new knowledge about coaches' awareness of the health effects of ST and their perception of ST use among Ontario athletes.

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Unhealthy behaviours among Canadian adolescents: prevalence, trends and correlates

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Abstract

Introduction: This study examines (1) time trends in the prevalence of selected unhealthy behaviours among adolescents aged 12 to 17 years, (2) the most commonly adopted combinations of unhealthy behaviours, and (3) socio-economic and sociodemographic correlates of unhealthy behaviours among adolescents.

Methods: A secondary analysis used data collected from 13 198 Canadian Community Health Survey (CCHS) respondents in 2000/2001 and 11 050 CCHS respondents in 2007/2008.

Results: Although the proportion of adolescents consuming a healthy diet increased over the study period, about 50% are still consuming insufficient amounts of fruit and vegetables. In both cycles over one-third of adolescents aged 15 to 17 years reported drinking alcohol regularly. Income level, education level, sex, and language spoken at home were significantly associated with the odds of engaging in unhealthy behaviours among those aged 12 to 14 years, while income level was no longer associated with the odds of engaging in unhealthy behaviours among those aged 15 to 17 years. For both age groups, a language other than French or English spoken in the home was associated with a low risk of unhealthy behaviours.

Conclusion: There was a general decrease in unhealthy behaviours among younger adolescents aged 12 to 14 years.

Keywords: adolescents' health, alcohol, smoking, healthy eating, body weight, physical activity

Introduction

Unhealthy behaviours in adolescence, such as smoking, physical inactivity, unhealthy eating (for example, consuming less fruit and vegetables than recommended) and alcohol drinking, contribute to chronic diseases in adulthood.[1,2,3] Young adults who reported having their first alcoholic drink at the age of 11 to 14 years experienced an increased risk of alcohol-related diseases,[1] such as certain cancers and heart and vascular disease,[4] as well as an increased risk of adverse impact on brain development.[4,5] Chronic health conditions, in turn, have significant adverse effects on quality of life and productivity.[3,6]

Physical inactivity and unhealthy eating lead to overweight and obesity, risk factors for a large number of chronic health complications such as cardiovascular disease, hypertension, type 2 diabetes, stroke, sleep apnea and certain types of cancer as well as complications in pregnancy and during surgery.[7] Obesity has also been implicated as a risk factor for functional limitations and poor health-related quality of life.[8,9]

In studies using national samples of high school students in the United States, almost one-quarter were overweight[10,11] and 13.6% obese.[11] More than three-quarters (78.4%) of a U.S. national sample of young adults aged 18 to 24 years consumed less than five fruits and vegetables per day, and 43.2% reported insufficient or no physical activity.[12] Similar rates have been observed in Canadian youth: based on national data of Canadian children aged 7 to 13 years, Tremblay and Willms reported an increase of 0.1 kg/m^2 per year in body mass index (BMI) between 1981 and 1996.[13] These authors also reported a 28.8% and 23.6% prevalence of overweight in boys and girls, respectively.[13]

Seo et al. reported that the prevalence of smoking among high school students increased from 21.9% in 2003 to 23.0% in 2005.[11] Pisetsky et al. found similar rates of current smoking among adolescents.[14] About one-third (34.3%) of students in grades 7 to 12 living in the Atlantic provinces in Canada reported smoking cigarettes.[15]

Seo et al. also reported a detrimental correlation between smoking and unhealthy eating.[11] Smoking among U.S. high school students was associated with being overweight, and this association became stronger between 1999 and 2005.[11]

Pisetsky et al. found that 22.0% of female and 27.7% of male high school students binge drink, that is, consume 5 or more alcoholic drinks in one sitting at least once a month.[14] In a sample of young adults aged 18 to 24 years living in the U.S., 28.9% reported being current smokers

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and 30.1% reported binge drinking.[12] A national survey of 4296 Canadian adolescents found that 29% of those aged 14 to 15 years reported drinking to intoxication.[16] Over half (53.6%) of students in grades 7 to 12 living in the Atlantic provinces of Canada reported using alcohol.[15]

Differences exist in the prevalence of health-risk behaviours by socio-economic status, sex and ethnicity. Wardle et al. found that adolescents from more deprived neighbourhoods were more likely to have tried smoking, to eat a high fat diet and to be overweight; these differences persisted after controlling for ethnicity.[2] On the other hand, Tremblay and Willms found that levels of physical activity and sedentary behaviour partially accounted for the association between socio-economic status and overweight/obesity in Canadian children aged 7 to 11 years.[17] In a recent study of Californian adolescents aged 12 to 17 years, the prevalence of obesity increased significantly between 2001 and 2007 among lower-income adolescents but not among higher-income adolescents.[18]

A number of studies have shown that, compared to adolescent boys, adolescent girls are generally more fixated on their body weight and more engaged in weight control methods, some of which are unhealthy, for example, cigarette smoking and using diet pills or laxatives.[10,19-21] Garry et al. also reported a strong association between the use of diet pills and vomiting/laxative-use with alcohol use and cigarette smoking in middle school students.[20] Allison et al. found that daily smoking decreased as education level increased, but that this decrease was not associated with income level.[22] More recently, Kestila et al. examined the relationship between childhood social circumstances and overweight in young adults aged 18 to 29 years.[23] The researchers found that being overweight was associated with low parental education and irregular parental employment in women, but not in men. Women who lived in rural municipalities in childhood were more likely to be obese than those from semi-urban or urban municipalities.[23]

Knowing the types and frequency of adolescents' unhealthy behaviours as well as the rate of their engagement is essential for planning prevention, intervention and outreach programs aimed at increasing the health of Canadians. Policy makers would also benefit from an examination of the time trends (years) of the unhealthy behaviours as well as the identification of groups of youth at high risk of engaging in such behaviours, information that is currently lacking. This study is an attempt to fill these gaps in knowledge. Specifically, the aim of this research is to (1) examine trends in the prevalence of obesity or overweight and unhealthy behaviours such as low physical activity, unhealthy eating (e.g. the consumption of less fruit and vegetables than recommended for this age group) and alcohol drinking in a nationally representative sample of Canadian adolescents aged 12 to 17 years between 2000/2001 and 2007/2008; (2) investigate the most common combinations of unhealthy behaviours adopted by adolescents by sex; and (3) identify the sociodemographic and economic attributes associated with engaging in unhealthy behaviours in younger as well as older adolescents.

Methods

Sample

This research used data collected in two cycles of the Canadian Community Health Survey (CCHS) under the authority of the *Canadian Federal Statistics Act*.[24] This cross-sectional survey, conducted every two years, uses a multistage stratified cluster probability sampling in which a dwelling is the final sampling unit. The survey sample was stratified by province/territory and urban versus rural regions within each province/territory. Sampling was designed to represent 98% of the Canadian population aged 12 years or more who lived in private dwellings in the ten provinces and the three territories. In both cycles, approximately half of the respondents were randomly selected to be interviewed face-to-face using the computer-assisted personal interviewing method, and half were interviewed by telephone using the computer-assisted telephone interviewing method.[24,25] Introductory letters mailed to selected respondents assured them of the confidentiality laws governing the release and/or publication of collected data and of the voluntary nature of participation. Interviewers obtained verbal permission from parents/guardians to interview youth aged between 12 to 15 years and explained the purpose of collecting the data, the subjects to be covered and the need to respect a child's right to privacy and confidentiality. If a youth could not be privately interviewed either in person or over the phone, the interview was coded as a refusal. More details about the survey design are published elsewhere.[24,25] There were 13 198 respondents aged 12 to 17 years in the 2000/2001 survey and 11 050 in the 2007/2008 survey.

Measures

Alcohol drinking was measured using two variables: frequency of drinking and binge drinking. Frequency of drinking was based on the respondent's drinking habits in the 12 months before the survey (regular, occasional, did not drink). A regular drinker drank alcohol once a month or more often during the year before the survey, and an occasional drinker drank alcohol less frequently. Binge drinking was defined as consuming five or more alcohol drinks in one sitting at least once a month.

Cigarette smoking was measured using one variable, frequency of smoking. Respondents were asked: "At the present time, do you smoke cigarettes daily, occasionally or not at all?" Responses were categorized as "daily smoker," "occasional smoker" and "non-smoker."

BMI classification was based on the age- and sex-specific BMI cut-off points as defined by Cole et al. for 12 to 18 year olds.[26] These, in turn, were based on pooled international data from Brazil, Great Britain, Hong Kong, Netherlands, Singapore and the U.S.[26] The authors used heights and weights of over 192 000 individuals to develop age- and sex-specific cut-off points for BMI categories for 12- to 18-year-olds. Cut-off points were specific for each sex and year of age, and ranged between 21.22 kg/m^2 and 30.0 kg/m^2 for boys and from 21.68 kg/m^2 and 30.0 kg/m^2 for girls. This variable classifies adolescents (except girls aged 15 to 17 years who were either pregnant or did not answer whether they were pregnant or not) as "obese," "overweight" or "neither obese nor overweight."

Other variables of health used in the analysis included daily consumption of fruit and vegetables (less than five servings versus five or more servings) as a marker for an unhealthy diet, and perceived general health (excellent/very good, good and fair/poor). Data on self-perceived stress were collected only from respondents 15 years or more in response to the following question: "Thinking about the amount of stress in your life, would you say that most days are not at all stressful / not very stressful / a bit stressful / quite a bit stressful / extremely stressful?"

Physical activity was measured using two variables, level of physical activity and time spent in sedentary activities. Level of physical activity categorizes respondents as being "active," for a total energy expenditure (EE) in their transportation and leisure activities of 3.0 kcal/kg/day or greater, "moderately active" for an EE of 1.5 kcal/kg/day or greater, but less than 3.0 kcal/kg/day, or "inactive" for an EE of less than 1.5 kcal/kg/day. Respondents' energy expenditure was calculated using the frequency and time per session of each physical activity and its metabolic energy cost (MET). For example, an activity of 4 METs requires 4 times the amount of energy as compared to when the body is at rest. The amount of metabolic energy used in a 15-minute session of each leisure activity (MET) was calculated and multiplied by the number of sessions to get the total energy expenditure (EE) corresponding to each activity. Survey respondents were not asked to specify the intensity level of their activities; therefore, the MET values calculated here correspond to the low intensity value of each activity. This approach was adopted because people tend to overestimate the intensity, frequency and duration of their activities.[24]

The total number of hours spent in sedentary activities in a typical week in the three months before the survey was also estimated. Sedentary activities included using a computer (including playing computer games and surfing the Internet), playing video games, watching television or videos and reading. The time spent at school or work was not included. Respondents' sedentary activities were then classified into four categories: less than 15 hours/week, 15 to 29 hours/week, 30 to 44 hours/week and 45 or more hours/week.

Sociodemographic characteristics used in this research included sex, age group (12–14 years and 15–17 years), language spoken at home (English/French versus other), place of birth (Canada versus other), highest level of education in the household (less than secondary school degree, secondary school graduate, some post-secondary education, post-secondary graduate), and income level. However, data on income level were reported differently in the two cycles of CCHS. In the 2000/2001 cycle, income adequacy was grouped into four levels, while in the 2007/2008 cycle it was grouped into three.[24] Consequently, a direct comparison of this variable could not be carried out.

Data analyses

Age-specific rates of engagement in health risk behaviours for the years 2000/2001 and 2007/2008 were calculated and compared, and used chi-square (χ^2) tests to compare the prevalence of unhealthy behaviours in the two cycles. χ^2 tests were also used to assess the bivariate relationships between unhealthy behaviours and various sociodemographic and economic attributes.

Unhealthy behaviours with more than two levels were recoded as yes/no variables. For example, "physically inactive" was coded as yes while "active" and "moderately active" were coded as no, "daily" and "occasional" cigarette smoking were coded as yes while "not at all" was coded as no, "regular" and "occasional" alcohol drinking were coded as yes and "non-drinker" as no. Data were then aggregated to show the most common combinations of unhealthy behaviours adopted by male and female adolescents separately.

Logistic regression models were used to examine the effects of sociodemographic and economic attributes associated with engaging in unhealthy behaviours in younger as well as older adolescents. Only those variables that were significantly associated with engagement in unhealthy behaviours in the bivariate tests were included in the multivariate analysis. Sampling weights were rescaled and used in all analyses. Rescaling the weights to have an average of one has two advantages. First, it takes into account the unequal probabilities of selection of survey respondents and adjusts the sample results to the demographic composition of the Canadian population so that the results represent the population of Canada and not just the sample itself. Second, it keeps the total sample size unchanged to guard against inflating the sample size for hypothesis testing.[24,25]

Results

Table 1 shows the descriptive statistics of all the variables used in the analysis. The most notable change over the study period was a 9 percentile point increase in the proportion of adolescents consuming five or more fruits/vegetables per day (12–14 years: $\chi^2 = 729.33$, $p < .001$; 15–17 years: $\chi^2 = 65.90$, $p < .001$). There was also a marked reduction in the prevalence of cigarette smoking for both age groups (12–14 years: $\chi^2 = 96.79$, $p < .001$; 15–17 years: $\chi^2 = 120.53$, $p < .001$).

Although the data showed slight improvement in the proportion of physically active adolescents, the number of hours spent in sedentary activities showed a bigger increase; the proportion of adolescents who spent more than 45 hours/week in sedentary activities increased from 6.1% to 8.3% among younger adolescents (12–14 years: $\chi^2 = 42.69$, $p < .001$) and from 3.8% to 9.0% among older adolescents (15–17 years: $\chi^2 = 170.00$, $p < .001$). There was also a significant improvement in BMI distribution for the younger adolescents (12–14 years: $\chi^2 = 23.43$, $p < .001$), but not for the older ones. Similarly, the prevalence of binge drinking improved significantly for the younger group (12–14 years: $\chi^2 = 13.30$, $p < .001$), but not for the older one.

Table 2 shows the number of unhealthy behaviours adopted by adolescents and their distribution based on age and sex. The proportion of younger adolescents (12–14 years) who had not adopted any unhealthy behaviours increased considerably (males: 25.2% to 36.4%; females: 26.7% to 38.5%) between 2000/2001 and 2007/2008. Among older

TABLE 1
Characteristics and descriptive statistics of adolescent respondents (aged 12–17 years) in the 2000/2001 and 2007/2008 Canadian Community Health Survey samples

	CCHS respondents, n (%)			
	12–14 years		15–17 years	
	2000/2001 (n = 6251)	2007/2008 (n = 5574)	2000/2001 (n = 6947)	2007/2008 (n = 5476)
Female	2993 (47.9)	2664 (48.7)	3459 (49.8)	2705 (49.4)
Income[a]				
Highest 30%	–	1684 (37.0)	–	1267 (32.1)
Middle 40%	–	1839 (40.4)	–	1741 (44.1)
Lowest 30%	–	1034 (22.6)	–	943 (23.0)
Language spoken at home				
English/French	–	5057 (90.7)	–	2914 (89.7)
Other	–	517 (9.3)	–	561 (10.3)
Country of birth				
Canada	5551 (88.8)	4913 (88.9)	6058 (87.2)	4744 (87.9)
Other	701 (11.2)	611 (11.1)	890 (12.8)	655 (12.1)
Education within the household				
Less than secondary school	508 (8.3)	188 (4.3)	533 (7.9)	186 (4.2)
Secondary school graduate	898 (14.7)	478 (10.9)	986 (14.6)	576 (12.9)
Some post-secondary	449 (7.3)	248 (5.6)	621 (9.2)	305 (6.8)
Post-secondary graduate	4264 (69.7)	3487 (79.2)	4627 (68.4)	3410 (76.2)
Self-perceived health				
Excellent/very good	4546 (72.7)	3902 (70.1)	4877 (70.2)	3749 (68.5)
Good	1461 (23.4)	1478 (26.5)	1690 (24.3)	1438 (26.3)
Fair/poor	242 (3.9)	191 (3.4)	378 (5.4)	289 (5.3)
Self-perceived stress[b]				
None	–	–	–	2261 (41.4)
A bit	–	–	–	2404 (44.0)
A lot	–	–	–	802 (14.6)
BMI, kg/m^2				
Obese[c]	310 (5.2)**	193 (4.2)	295 (4.3)	229 (4.6)
Overweight[d]	1011 (17.0)	643 (14.1)	981 (14.4)	758 (15.1)
Neither	4636 (77.8)	3724 (81.7)	5528 (81.2)	4028 (80.3)
Daily consumption of fruit/vegetables, servings				
< 5	3591 (58.5)**	2486 (50.1)	4050 (59.1)**	2665 (51.6)
≥ 5	2547 (41.5)	4608 (49.9)	2808 (40.9)	2497 (49.4)
Physical activity				
Active	2595 (49.4)*	2724 (51.7)	2699 (44.0)**	2583 (48.5)
Moderately active	1347 (25.6)	1202 (22.8)	1461 (23.8)	1150 (21.6)
Inactive	1310 (24.9)	1346 (25.5)	1976 (32.2)	1597 (30.0)
Sedentary activities, hours/week				
< 15	973 (30.1)**	1345 (26.0)	1404 (35.7)**	1414 (26.7)
15–29	1481 (45.8)	2256 (43.6)	1761 (44.8)	2358 (44.6)
30–44	583 (18.0)	1145 (22.1)	615 (15.6)	1045 (19.8)
≥ 45	198 (6.1)	427 (8.3)	149 (3.8)	474 (9.0)

Continued on the following page

TABLE 1 (continued)
Characteristics and descriptive statistics of adolescent respondents (aged 12–17 years) in the 2000/2001 and 2007/2008 Canadian Community Health Survey samples

	CCHS respondents, n (%)			
	12–14 years		15–17 years	
	2000/2001 (n = 6251)	2007/2008 (n = 5574)	2000/2001 (n = 6947)	2007/2008 (n = 5476)
Cigarette smoking				
Daily	185 (3.0)**	51 (0.9)	1005 (14.5)**	450 (8.2)
Occasional	190 (3.0)	82 (1.5)	435 (6.3)	307 (5.6)
Non-smoker	5877 (94.0)	5430 (97.6)	5508 (79.3)	4703 (86.1)
Alcohol drinking				
Regular	335 (5.4)**	219 (3.9)	2288 (33.2)*	1859 (34.3)
Occasional	1069 (17.2)	747 (13.5)	1987 (28.9)	1410 (26.0)
Non-drinker	3809 (77.4)	4581 (82.6)	2609 (37.9)	2155 (39.7)
Binge drinking				
Yes	68 (1.1)**	27 (0.05)	920 (13.2)	683 (12.6)
No	6184 (98.9)	5521 (99.5)	6028 (86.8)	4723 (86.4)

Abbreviations: BMI, body mass index; CCHS, Canadian Community Health Survey.

[a] Income level was grouped differently in the 2000/2001 CCHS survey compared to the 2007/2008 survey.

[b] Only asked of respondents ≥ 15 years in 2007/2008.

[c] BMI 26.02 kg/m^2 for males aged 12–14 years, > 30.0 kg/m^2 for males aged 15–17 years, 26.67 kg/m^2 for females aged 12–14 years and > 30.00 kg/m^2 for females aged 15–17 years.

[d] BMI 21.22 kg/m^2 for males aged 12–14 years, 30.0 kg/m^2 for males aged 15–17 years, 21.68 kg/m^2 for females aged 12–14 years and 30.0 kg/m^2 for females aged 15–17 years.

* $p < .01$ for the difference in prevalence over the study period (χ^2 tests).

** $p < .01$ for the difference in prevalence over the study period (χ^2 tests).

TABLE 2
Canadian Community Health Survey adolescent respondents (aged 12–17 years) engaging in unhealthy behaviours by age group and sex, 2000/2001 and 2007/2008

Age group, years	CCHS survey respondents, n (%)	Number of unhealthy behaviours					
		0	1	2	3	≥4	Total
12–14	2000/2001*						
	Male	820 (25.2)	1522 (46.7)	738 (22.6)	163 (5.0)	15 (0.5)	3258
	Female	800 (26.7)	1323 (44.2)	710 (23.7)	129 (4.3)	32 (1.1)	2993
	2007/2008						
	Male	1041 (36.4)	1136 (39.7)	592 (20.7)	85 (3.0)	7 (0.2)	2862
	Female	1045 (38.5)	1076 (39.7)	508 (18.7)	70 (2.6)	14 (0.5)	2714
15–17	2000/2001*						
	Male	546 (15.7)	1139 (32.7)	999 (28.6)	498 (14.3)	307 (8.8)	3488
	Female	631 (18.3)	1152 (33.3)	972 (28.1)	416 (12.0)	288 (8.4)	3459
	2007/2008**						
	Male	577 (20.8)	899 (32.5)	755 (27.3)	367 (13.3)	170 (6.1)	2768
	Female	548 (20.3)	910 (33.6)	829 (30.6)	275 (10.2)	145 (5.3)	2707

Abbreviation: CCHS, Canadian Community Health Survey.

Note: All data are weighted by the rescaled weights. The average of the rescaled weights being 1, many of the data would be fractions; therefore, the totals in different analyses may not be exactly equal due to approximation.

* $p < .01$ for the difference between male and female adolescents (χ^2 tests).

** $p = .001$ for the difference between male and female adolescents (χ^2 tests).

adolescents (15–17 years), this increase was more modest (males: 15.7% to 20.8%; females: 18.3% to 20.3%).

Consuming less than five servings of fruit and vegetables was the most common unhealthy behaviour among both male and female adolescents who had adopted one such behaviour (males: 57.3%; females: 47.9%). Table 3 shows other unhealthy behaviours by frequency and sex. For male adolescents, the second most common unhealthy attributes were being overweight or obese (15.6%) and physically inactive (15.0%) followed by regular alcohol drinking (10.5%) and daily smoking (1.3%). Of female adolescents, 30.0% were inactive, 11.6% drank alcohol regularly, 9.0% were overweight or obese and 1.6% smoked daily.

The most common combination of unhealthy behaviours among adolescents with two such behaviours was insufficient consumption of fruit/vegetables and physical inactivity (35.3% in males and 51.1% in females) (Table 3). The second most common combination among male adolescents was insufficient consumption of fruit/vegetables and overweight/obesity (27.8%), while among female adolescents it was insufficient consumption of fruit/vegetables and regular alcohol drinking (13.7%). Eight percent of male adolescents and 5.7% of female adolescents with two unhealthy behaviours combined regular alcohol drinking with binge drinking. Only 1.8% of males and 1.4% of females combined regular alcohol dinking with daily cigarette smoking (Table 3).

Results of the bivariate χ^2 tests show that sex, income level, education level and language spoken at home were associated with engaging in unhealthy behaviours for younger adolescents (12–14 years) while place of birth was not. For the older group (15–17 years), only sex, education level and language spoken at home were significantly associated with engaging in unhealthy behaviours while self-perceived stress level, place of birth and income were not.

Results of the logistic regression analysis indicate that education level, sex and language spoken at home were significantly associated with the probability of engaging in at least one unhealthy behaviour among adolescents (Table 4). These probabilities were slightly higher for boys aged 12 to 14 years compared with their female counterparts (odds ratio [OR] = 1.18, 95% confidence interval [CI] = 1.03–1.34), but lower for boys aged 15 to 17 years compared to females in that age range (OR = 0.83, 95% CI = 0.70–0.97). Respondents speaking languages other than English/French at home had a lower risk of engaging in unhealthy behaviours (12–14 years: OR = 0.66, 95% CI = 0.51–0.85; 15–17 years: OR = 0.60, 95% CI = 0.46–0.80). Adolescents in households where the highest level of education was a high school certificate had almost twice the risk of engaging in unhealthy behaviours compared with those in households with a post-secondary degree (12–14 years: OR = 1.93, 95% CI = 1.51–2.46; 15–17 years: OR = 1.46, 95% CI = 1.11–1.92).

Discussion

In this study, I examined prevalence of smoking, obesity and overweight, physical inactivity, unhealthy eating and alcohol drinking in a nationally representative sample of Canadian adolescents in 2000/2001 and 2007/2008. This study also investigated trends of engaging in these behaviours for younger (12–14 years) and older (15–17 years) adolescents and for male and female adolescents separately, as well as the types of unhealthy behaviours adopted by adolescents and the most common combinations of such behaviours.

TABLE 3
Types of unhealthy behaviours adopted by Canadian Community Health Survey adolescent respondents by sex, 2007/2008

Number and type/combination of unhealthy behaviours		CCHS respondents, n (%)	
		Males (n = 2035)	Females (n = 1986)
One	Eats less than 5 servings of fruit/vegetables per day	1171 (57.3)	951 (47.9)
	Overweight/obese	318 (15.6)	178 (9.0)
	Physically inactive	305 (15.0)	595 (30.0)
	Regular alcohol drinking	214 (10.5)	231 (11.6)
	Daily smoking	26 (1.3)	31 (1.6)
		Males (n = 1347)	**Females (n = 1337)**
Two	Eats less than 5 servings of fruit/vegetables + physically inactive	467 (34.7)	683 (51.1)
	Eats less than 5 servings of fruit/vegetables + overweight/obese	374 (27.8)	156 (11.7)
	Eats less than 5 servings of fruit/vegetables + regular alcohol drinking	176 (13.1)	183 (13.7)
	Regular alcohol drinking + binge drinking	111 (8.2)	76 (5.7)
	Regular alcohol drinking + overweight/obese	73 (5.4)	37 (2.8)
	Regular alcohol drinking + physically inactive	34 (2.5)	76 (5.7)
	Regular alcohol drinking + daily smoking	24 (1.8)	18 (1.4)
	Eats less than 5 servings of fruit/vegetables + daily smoking	10 (0.7)	26 (1.9)

Abbreviation: CCHS, Canadian Community Health Survey.

TABLE 4
Results of logistic regression analysis of sociodemographic and economic correlates of adopting unhealthy behaviours by adolescents aged 12–17 years, Canada, 2007/2008

Age group, years	Variable	OR (95% CI)	*p*
12–14	Income distribution		
	Lowest 30%	1.20 (1.00–1.44)	.053
	Middle 40%	1.23 (1.03–1.45)	.017
	Highest 30%	1.00 (ref)	–
	Level of education in household		
	Less than secondary school	1.47 (1.04–2.08)	.027
	Secondary school graduate	1.93 (1.51–2.46)	< .001
	Some post-secondary	1.27 (0.96–1.70)	.100
	Post-secondary graduate	1.00 (ref)	–
	Language spoken at home		
	English/French	1.00 (ref)	–
	Other	0.66 (0.51–0.85)	< .001
	Sex		
	Male	1.18 (1.03–1.34)	.017
	Female	1.00 (ref)	–
15–17	Level of education within the household		
	Less than secondary school	1.53 (0.94–2.49)	.087
	Secondary school graduate	1.46 (1.11–1.92)	.006
	Some post-secondary	1.62 (1.10–2.40)	.015
	Post-secondary graduate	1.00 (ref)	–
	Language spoken at home		
	English/French	1.00 (ref)	–
	Other	0.60 (0.46–0.80)	< .001
	Sex		
	Male	0.83 (0.70–97)	.022
	Female	1.00 (ref)	–

Abbreviations: CI, confidence interval; OR, odds ratio; ref, reference.

Sociodemographic and economic correlates of engaging in unhealthy behaviours were also examined.

A limitation of this study arises from the fact that all the measures used were based on self-reported data, which is subject to bias.

While younger male adolescents had a slightly higher probability of engaging in unhealthy behaviours, older ones had a slightly lower probability compared with their female counterparts—a somewhat puzzling result that suggests the need for further research. This result underscores the importance of examining adolescents' behaviours separately for sex and for age.

In spite of the increase in the proportion of adolescents consuming sufficient amounts of fruit and vegetables daily, in 2007/2008 approximately half were still consuming less than the recommended amount. This proportion, however, is much lower than the 78% of U.S. youth reported consuming less than the recommended amount of fruit and vegetables.[11] While the proportion of obese or overweight adolescents aged 12 to 14 years decreased from 22.2% to 18.3% over the study period, the corresponding proportion of those aged 15 to 17 years remained almost the same at 19.7%. Although these rates are lower than those observed in the 1990s,[11] they are still far from ideal and hence require the attention of health advocates and policy makers.

Over the study period, around one-third of the 15- to 17-year-olds reported drinking alcohol regularly during the previous year, a proportion similar to that reported elsewhere.[11]

The logistic regression results indicated that language spoken at home and parents' education level are the most important demographic correlates of unhealthy behaviours among adolescents. Adolescents who speak languages other than English/French at home had a much lower probability of engaging in unhealthy behaviours. Lower levels of parental education were associated with a higher probability of unhealthy behaviours among younger as well as older adolescents, evidence supported by other research findings.[11] Low income was associated with higher odds of unhealthy behaviours among younger adolescents, but not among older ones.

Conclusion

This study was based on secondary data analysis of nationally representative samples of adolescents aged 12 to 17 years that were collected in the 2000/2001 and 2007/2008 cycles of the CCHS. The study indicated a general decrease in unhealthy behaviours among younger adolescents aged 12 to 14 years. More outreach and health educational programs should target older adolescents with a special focus on combating the detrimental effects of unhealthy eating, physical inactivity and alcohol drinking.

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Longitudinal trends in mental health among ethnic groups in Canada

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Abstract

Introduction: Immigration continues to transform the ethnic composition of the Canadian population. We investigated whether longitudinal trends in mental distress vary between seven cultural and ethnic groups and whether mental distress within the same ethnic group varies by demographic (immigrant status, sex, age, marital status, place and length of residence), socio-economic (education, income), social support and lifestyle factors.

Method: The study population consisted of 14 713 respondents 15 years and older from the first six cycles of the National Population Health Survey (NPHS); 20% reported themselves to be immigrant at Cycle 1, in 1994/1995. The logistic regression model was fitted by modifying a multivariate quasi-likelihood approach, and robust variance estimates were obtained by using balanced repeated replication techniques.

Results: Based on the multivariable model and self-reported data, we observed that female respondents were more likely to report moderate/high mental distress than male respondents; younger respondents more than older respondents; single respondents more than those in a relationship; urban dwellers more than rural dwellers; less educated respondents more than more educated respondents; current and former smokers more than non-smokers; and those living in a smoking household more than those living in non-smoking households. The relationship between ethnicity and mental distress was modified by immigrant status, sex, social involvement score and education. Confirming other research, we found an inverted U-shaped relationship between length of stay and mental distress: those who had lived in Canada for less than 2 years were less likely to report moderate/high mental distress, while those who had lived in Canada for 2 to 20 years were significantly more likely to report moderate/high mental distress than those who had lived in Canada for more than 20 years.

Conclusion: There is a need to develop ethnicity-specific mental health programs targeting those with low education attainment and low social involvement. Policies and programs should also target women, the younger age group (15–24 years) and low-income adequacy groups.

Keywords: mental distress, ethnicity, National Population Health Survey, generalized estimating equations, balanced repeated replication, missing data, pattern mixture models

Introduction

According to the World Health Organization, more than 25% of people worldwide will experience mental illness at some time during their lives.[1] In Canada, approximately 30% of disability claims are based on mental illnesses, costing between $15 billion and $33 billion dollars annually.[2] As with physical health, mental health is an interplay between demographic, lifestyle, social and environmental factors, among others. Some examples of these are age, sex, marital status, personal smoking habits, exposure to second-hand smoke, socio-economic status and social involvement.[3-6] Immigrants may be at particular risk of developing mental illnesses such as depression, and the risk may vary with the length of time since their arrival in Canada.[7] Variation between ethnic groups is also likely; therefore it is important to explore associations between the ethnicity of immigrants and mental health.

Despite its importance and relevance for policy making, the literature on the issue of ethnicity and mental health is very limited.[3] Including ethnicity in health research would improve targeting of resources to more vulnerable groups. Canadian immigrants are heterogeneous with respect to many factors such as country of origin, age group, education, income and ethnicity.[8] These factors need to be accounted for when analyzing health data because they are likely to affect the physical and mental health of individuals.

The objectives of this report were to investigate (1) how longitudinal trends in mental distress, used as a measure of mental health, vary between ethnic groups in Canada; (2) whether these trends vary between immigrant and Canadian-born members of different ethnic groups; and (3) how other variables influence the relationship between mental health and

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ethnicity, in particular, socio-economic, social support and lifestyle status, and demographic factors.

Methods

Study design and study population

Statistics Canada has used complex, multi-stage sampling designs to collect data over time from cohorts of individuals.[9] One such survey, the Canadian National Population Health Survey (NPHS), includes a set of questions designed to investigate the mental health of respondents.[10] Details of the NPHS and multi-stage sampling design can be found elsewhere.[10,11] Our study population consisted of the 14 713 respondents aged 15 years and older who were surveyed over the first six cycles of the NPHS, from 1994/1995 to 2004/2005.

Variables

Dependent variable. Mental distress, used as a measure of mental health, was computed using a six-item "distress scale" that assessed feelings of sadness, nervousness, restlessness, hopelessness and worthlessness within the preceding month. Also assessed was the frequency with which an individual felt that everything was an effort. The distress scale was based on the work of Kessler et al.[11] and was derived from the Composite International Diagnostic Interview'. Scores on the distress scale ranged from zero (no distress) to 24 (highly distressed). The derived distress scale was highly skewed and was therefore categorized into a dichotomous mental distress variable (i.e. no/low [0–5 on the distress scale] and moderate/high [6–24 on the distress scale]), as suggested by a geriatric psychiatrist (Personal communication, 27 October, 2010) and based on the available literature.[12,13]

Independent variables. The main risk factor of interest was ethnicity, which we determined from self-reported ethnicity in response to the NPHS question, "To which ethnic or cultural group(s) did your/his/her ancestors belong?" The possible responses were coded[10] and categorized into seven groups according to ethnic or cultural ancestry: British, Eastern European, Western European, Chinese, South Asian, Black and Other.

Other independent variables of interest were demographic (immigrant status, sex, age, marital status, place of residence and length of residence), location of residence (rural vs. urban[†])[10], geographical area of residence (one of the 10 provinces), socio-economic status (education, income), social support status and lifestyle status. Income adequacy was derived from various combinations of total household income and the number of people living in the household, and was categorized into three groups, low, middle and high.[17] The social support variable consisted of a social involvement score (SIS)[14] based on questions on the respondents' frequency of participation in associational activities and of attending religious services. Lifestyle variables consisted of a respondent's personal smoking history and household smoking status. The general health variable consisted of a self-perceived general health status. Five dummy variables for 'Cycle' were used to study the effect of time on mental distress.

Statistical methods

We used SAS (SAS Institute Inc., version 9.2, 2007) procedure PROC GENMOD to fit the multivariable logistic regression model and to obtain the predictive model for mental distress.[18] The longitudinal weight variable computed by Statistics Canada methodologists was used in the WEIGHT statement of SAS syntax to account for unequal probability of selection. Based on the goodness-of-fit techniques, we determined within-subject correlation structure.[19] We obtained the estimates of regression coefficients for the logistic regression model by modifying the multivariate quasi-likelihood approach for complex survey designs using the weight variable.[20]

The robust variance estimation in GENMOD based on generalized estimation equations (GEE) approach accounts only for the within-subject dependencies due to the repeated measurements over time,[20,21] and does not account for design effects (stratification, clustering and unequal probability of selection). In order to allow for robust variance estimation without compromising respondents' privacy, Statistics Canada provides pre-calculated bootstrap weights with the survey. A resampling technique known as balanced repeated replication (BRR) is used for robust variance estimation. We used the BRR features of STATA (StataCorp LP, version 11, 2009), which for our purposes with pre-calculated bootstrap weights is equivalent to the bootstrapping method.[22] A classical multivariable logistic regression model based on the GEE approach was extended by including a categorical dropout variable to incorporate the missing observations. The categorical dropout variable included four categories numbered consecutively from one to four: one missing value for the response variable; two or more missing values for the response variable; deceased during study duration; and no missing value or completers (subjects who participated in all the six cycles). Models such as these that incorporate a missing pattern are called pattern-mixture models.[23] If a value was missing for any covariate for any particular cycle, then the entire observation was deleted from the multivariable analysis.

Multivariable statistical analyses were conducted in two steps. In the first, we used the GEE approach to conduct the analysis. In the second, the final model obtained in the first step was extended by including a categorical dropout variable. The dropout variable was statistically significant as a main effect and also as an effect modifier of the relationship between ethnicity and mental distress. Hence, the pattern-mixture model was used for prediction purposes. Standard errors were computed using the BRR resampling technique, which accounts for the complexities of stratified multi-stage design.

[†] http://www.hcp.med.harvard.edu/statcalc/index.php

[‡] Urban area is defined as area that has a minimum population concentration of 1000 or more and a population density of at least 400 per square kilometre based on previous census counts.[9] Rural areas are residual of urban areas.[10]

The main risk factor of interest was ethnicity, which was adjusted for demographic, socio-economic, social support and lifestyle factors as main effects. Various interaction terms were tested in the multivariable model for statistical significance.

The final predictive model was used to determine the predicted probabilities for the moderate/high mental distress category.

Results

The study population consisted of 14 713 respondents 15 years and older. The 20% of respondents who self-reported as immigrants at baseline described themselves as belonging to the following ethnic groups: British, 37.6%; Eastern European, 4.6%; Western European, 36.4%; Chinese, 2.4%; South Asian, 1.6%; Black, 1.0%; and Other, 16.4%. At baseline, 78.2% respondents reported having no/low mental distress and 21.8% moderate/high distress. Table 1 shows the baseline characteristics of the study population stratified by mental distress status (no/low vs. moderate/high) in terms of weighted percentages. Based on standard model-building techniques,[24] these variables were selected for the multivariable modeling. Results based on the final multivariable model are shown in Table 2 (main effects) and Table 3 (interaction terms).

Table 2 shows the relationship between mental distress and the variables of interest. Female respondents were more likely to self-report mental distress than were male respondents (adjusted odds ratio [OR_{adj}] = 1.69, 95% confidence interval [CI]: 1.48–1.94). Younger respondents were more likely to self-report mental distress (15–24 years: OR_{adj} = 2.67, 95% CI: 2.21–3.22; 25–54 years: OR_{adj} = 2.23, 95% CI: 1.95–2.56; 55–69 years: OR_{adj} = 1.23, 95% CI: 1.08–1.41; reference category ≥ 70 years). Respondents who were either married, in common-law relationships or in partnerships (OR_{adj} = 0.69, 95% CI: 0.62–0.76) had significantly lower risk of moderate/high mental distress compared to single respondents. Rural residents had a significantly lower risk of reporting moderate/high mental distress than their urban counterparts (OR_{adj} = 0.87, 95% CI: 0.79–0.97), while the geographical area of residence was also a significant predictor: Quebec residents were at a significantly higher risk of reporting moderate/high distress compared to Ontario residents (OR_{adj} = 1.46, 95% CI: 1.31–1.64). The relationship between length of stay in Canada and mental distress was in the shape of an inverted *u*: those who had lived in Canada for less than 2 years were less likely to report moderate/high mental distress, while those who had lived in Canada for 2 to 20 years were significantly more likely to report moderate/high mental distress than those who had lived in Canada for more than 20 years.

We also observed an inverse dose-response relationship for income adequacy levels: the respondents in the low-income adequacy category were more likely to report moderate/high mental distress than the high-income adequacy group (OR_{adj} = 1.35, 95% CI: 1.19–1.53).

Current smokers (OR_{adj} = 1.36, 95% CI: 1.21–1.52) and ex-smokers (OR_{adj} = 1.14, 95% CI: 1.04–1.24) were at a higher risk of reporting moderate/high mental distress compared to non-smokers, while those exposed to household smoke (OR_{adj} = 1.14, 95% CI: 1.05–1.25) were also at a significantly higher risk compared to those who were not exposed to household smoke.

The self-perceived general health status variable measures the overall self-reported health, physical and mental, of an individual. A dose-response relation was observed between general health status and probability of moderate/high mental distress, with those in poor health most likely to report mental distress (OR_{adj} = 13.40, 95% CI: 11.11–16.15 against the reference category, excellent general health status).

Canadian-born people of Eastern European ethnicity had the highest predicted probability of moderate/high mental distress at Cycle 1, declining sharply over time, in contrast to immigrants of Eastern European ethnicity, who were much less likely to report moderate/high mental distress (Figure 1). The predicted probability for moderate/high mental distress of immigrants of British ethnicity was higher than for Canadian-born people of British ethnicity; however, these probabilities were the lowest of all Canadian-born and immigrant respondents. The predicted probability for moderate/high mental distress for Canadian-born respondents of Black ethnicity was average (Figure 1) and did not change substantially over the six cycles; however, among immigrants of Black ethnicity there was a steep decrease in this probability from Cycle 1 to Cycle 2, followed by a sharp increase and substantially higher probability for moderate/high mental distress compared to other ethnicities.

Among the female respondents, South Asian females had the lowest probability of reporting moderate/high mental distress. Females of British ethnicity were less likely to self-report moderate/high levels of mental distress compared to those of other ethnicities (Figure 2). In contrast to South Asian females, South Asian males had the highest probability of reporting moderate/high mental distress among males. In contrast, males of British ethnicity were the least likely to report moderate/high mental distress compared to the other ethnicities (Figure 2).

Respondents of Chinese ethnicity with less education (≤ grade 12) had the highest predicted probability of reporting moderate/high mental distress, in contrast to those with an education beyond grade 12 (Figure 3, Table 3). This pattern was opposite for respondents of South Asian ethnicity; the predicted probability of reporting moderate/high mental distress was higher (with no particular pattern over time) for those who are educated beyond grade 12, with a slight decline from Cycle 1 to Cycle 2 that then levelled off. Similar trends were observed for respondents of Eastern and Western European ethnicities. For respondents of British ethnicity, the predicted probability of reporting moderate/high mental distress was slightly lower for those who were educated beyond grade 12.

Predicted probability of self-reporting moderate/high mental distress was highest for those who had a moderate SIS and lowest for those with high SIS for all groups except for those of Black ethnicity (Figure 4).

TABLE 1
Respondent characteristics at baseline (Cycle 1) of the National Population Health Survey

Variable	Self-reported mental distress		
	No/Low[a] %	Moderate/ High[a] %	OR (95% CI)[b]
Ethnicity			
Ethnic groups			
British	39.6	32.9	1.00
Eastern European	4.8	4.6	**1.03 (1.00–1.05)**
Western European	35.3	39.3	**1.04 (1.03–1.05)**
Chinese	2.1	3.0	1.02 (0.98–1.06)
South Asian	1.6	1.5	1.01 (0.97–1.06)
Black	1.0	1.2	1.01 (0.95–1.08)
Other	15.7	17.6	**1.04 (1.02–1.06)**
Demographic variable			
Immigrant status			
Canadian-born	81.5	79.7	1.00
Immigrant	18.5	20.3	1.01 (0.99–1.03)
Sex			
Male	49.4	39.3	1.00
Female	50.6	60.7	**1.07 (1.06–1.08)**
Age group, years			
15–24	14.2	25.1	**1.10 (1.08–1.12)**
25–54	59.2	56.0	**1.03 (1.01–1.04)**
55–69	16.8	11.7	0.99 (0.97–1.00)
≥70	9.9	7.2	1.00
Marital status			
Married, common law, partnership	65.4	49.5	**0.92 (0.91–0.93)**
Widowed, separated, divorced	12.6	15.8	**0.98 (0.97–1.00)**
Single	22.0	34.7	1.00
Residence			
Rural[c]	17.6	13.9	**0.98 (0.97–0.99)**
Urban[d]	82.4	86.1	1.00
Length of stay in Canada, years			
≤ 2	1.4	0.9	1.05 (0.99–1.11)
2–20	14.4	24.5	**1.07 (1.06–1.09)**
> 20	84.3	74.6	1.00
Geographical area			
Atlantic[e]	8.5	7.6	**0.99 (0.98–1.00)**
British Columbia	13.1	11.6	1.00 (0.98–1.01)
Prairies[f]	16.6	14.2	1.00 (0.98–1.01)
Quebec	23.9	31.7	**1.06 (1.04–1.08)**
Ontario	37.8	34.9	1.00
Socio-economic status			
Income adequacy[g]			
Low	16.1	25.4	**1.13 (1.11–1.14)**
Medium	67.0	62.7	**1.03 (1.02–1.04)**
High	16.9	11.9	1.00

Continued on the following page

TABLE 1 (continued)
Respondent characteristics at baseline (Cycle 1) of the National Population Health Survey

Variable	Self-reported mental distress		
	No/Low[a] %	Moderate/ High[a] %	OR (95% CI)[b]
Education			
≤ Grade 12	73.1	64.7	**1.06 (1.05–1.07)**
> Grade12	26.9	35.3	1.00
Social involvement score[h]			
Low	40.7	46.2	**1.06 (1.04–1.07)**
Moderate	37.4	38.4	**1.04 (1.03–1.06)**
High	21.9	15.4	1.00
Lifestyle			
Smoking status			
Current	27.8	40.9	**1.08 (1.07–1.10)**
Former	32.1	25.6	**1.01 (1.00–1.02)**
Never	40.1	33.6	1.00
Household smoking			
Yes	34.1	46.4	**1.07 (1.06–1.08)**
No	65.9	53.6	1.00
General health status			
Poor	1.0	6.4	**1.51 (1.46–1.56)**
Fair	6.4	15.4	**1.25 (1.23–1.28)**
Good	25.1	34.2	**1.12 (1.11–1.13)**
Very Good	39.1	30.6	**1.04 (1.03–1.05)**
Excellent	28.3	13.4	1.00

Abbreviations: CI, confidence interval; GEE, generalized estimating equations; OR, odds ratio; SIS, social involvement score.

Note: Bolded values are ones that are statistically significant.

[a] Weighted percentages.

[b] $p < .20$ based on the relationship between each of the risk factors and the outcome variable using GEE approach.

[c] Urban: An area that has a minimum population concentration of 1000 or more and a population density of at least 400 per square kilometre based on previous census counts.[16]

[d] Rural: Area residual of urban areas (see above).[16]

[e] Nova Scotia, Newfoundland and Labrador, New Brunswick, Prince Edward Island.

[f] Manitoba, Saskatchewan, Alberta.

[g] Based on total household income and household size.[16]

[h] The social involvement dimension is measured by two items that reflect the frequency of participation in associations or voluntary organizations and the frequency of attendance at religious services in the last year. SIS is used as a time-independent variable (computed for Cycle 1).[16]

TABLE 2
Relationship between self-reported mental distress and independent variables of interest (main effects) based on dichotomous logistic regression of the prevalence of self-reported mental distress

Variable	Adjusted odds ratio (OR_{adj}) of self-reported mental distress (95% CI)
Ethnicity	
Ethnic groups (Ref: British)	1.0
Eastern European	1.72 (0.75–3.90)
Western European	1.28 (0.88–1.85)
Chinese	0.45 (0.09–2.33)
South Asian	2.93 (0.36–23.82)
Black	1.80 (0.13–25.36)
Other	1.52 (0.91–2.52)
Demographic status	
Immigrant status (Ref: Canadian-born)	1.0
Immigrant	0.89 (0.67–1.18)
Sex (Ref: Male)	1.0
Female	**1.69 (1.48–1.94)**
Age group, years (Ref: ≥ 70)	1.0
15–24	**2.67 (2.21–3.22)**
25–54	**2.23 (1.95–2.56)**
55–69	**1.23 (1.08–1.41)**
Marital status (Ref: Single)	1.0
Married/common law/partnership	**0.69 (0.62–0.76)**
Widowed/separated	0.98 (0.87–1.10)
Residence (Ref: Urban)[a]	1.0
Rural[b]	**0.87 (0.79–0.97)**
Length of residence, years (Ref: > 20)	1.0
≤ 2	0.78 (0.46–1.33)
2–20	**1.27 (1.09–1.49)**
Geographical area (Ref: Ontario)	1.0
Atlantic[c]	0.97 (0.86–1.09)
British Columbia	1.01 (0.89–1.15)
Prairies[d]	0.94 (0.84–1.04)
Quebec	**1.46 (1.31–1.64)**
Socio-economic status	
Income adequacy (Ref: High)[e]	1.0
Low	**1.35 (1.19–1.53)**
Medium	1.04 (0.86–1.25)
Education (Ref: > Grade 12)	1.0
≤ Grade 12	**1.21 (1.06–1.39)**
Social support status[f]	
SIS (Ref: High)	1.0
Low	1.14 (0.95–1.37)
Moderate	1.04 (0.86–1.25)

Continued on the following page

TABLE 2 (continued)
Relationship between self-reported mental distress and independent variables of interest (main effects) based on dichotomous logistic regression of the prevalence of self-reported mental distress

Variable	Adjusted odds ratio (OR_{adj}) of self-reported mental distress (95% CI)
Lifestyle status	
Smoking status (Ref: Never smoked)	1.0
Current smoker	**1.36 (1.21–1.52)**
Former smoker	**1.14 (1.04–1.24)**
Household smoking (Ref: No)	1.0
Yes	**1.14 (1.05–1.25)**
General health status	
(Ref: Excellent)	1.0
Poor	**13.40 (11.11–16.15)**
Fair	**5.77 (5.07–6.57)**
Good	**2.85 (2.58–3.15)**
Very Good	**1.54 (1.41–1.69)**
Time point	
(Ref: Cycle 1)	1.0
Cycle 6	**0.75 (0.66–0.84)**
Cycle 5	**0.65 (0.58–0.72)**
Cycle 4	**0.58 (0.52–0.63)**
Cycle 3	**0.73 (0.66–0.81)**
Cycle 2	**0.68 (0.63–0.74)**
Drop (Ref: Completers)	1.0
Missing value = 1	1.13 (0.95–1.35)
Missing values ≥ 2	**1.28 (1.09–1.50)**
Died during the cycles	**1.26 (1.08–1.47)**

Abbreviations: CI, confidence interval; OR_{adj}, adjusted odds ratio; Ref, reference; SIS, social involvement score.

Note: Bolded values are statistically significant.

[a] Urban: An area that has a minimum population concentration of 1000 or more and a population density of at least 400 per square kilometre based on previous census counts.[16]

[b] Rural: Area residual of urban areas (see above).[16]

[c] Nova Scotia, Newfoundland and Labrador, New Brunswick, Prince Edward Island.

[d] Manitoba, Saskatchewan, Alberta.

[e] Based on total household income and household size.[16]

[f] The social involvement dimension is measured by two items that reflect the frequency of participation in associations or voluntary organizations and the frequency of attendance at religious services in the last year. SIS used as a time-independent variable (computed for Cycle 1).[16]

Respondents of Black ethnicity with one missing observation had an extremely high probability of reporting moderate/high mental distress, while those of Chinese ethnicity with two or more missing observations or who deceased during the study period had an extremely low probability of reporting moderate/high mental distress (Figure 5).

Discussion

Our results show that the relationship between ethnicity and mental distress was modified by immigrant status, sex, SIS, and education and by the missing data pattern variable (dropout). The predicted probability of moderate/high mental distress was slightly higher for immigrant versus Canadian-born respondents of all except Black ethnicity (Table 3) and the overall pattern of the longitudinal trend was similar for all immigrants of different ethnic groups except immigrants of Black ethnicity (Figure 1). We observed an inverted U-shaped relationship between length of stay in Canada and mental distress. These results support previous findings that the physical and mental health of immigrants deteriorates during the first couple of years after immigration, and then starts to improve slightly or to level off.[25-27]

Adjustment to a new country, for any individual, is a complex process. Some studies have shown that most new immigrants to any country experience some kind of mental or psychological distress during the first few years,[27,28] especially adolescents,[29-31] and that length of stay in the new country plays an important role in the development of well being.[27-29]

TABLE 3
Relationship between self-reported mental distress and ethnicity as modified by several factors based on dichotomous logistic regression of the prevalence of self-reported mental distress

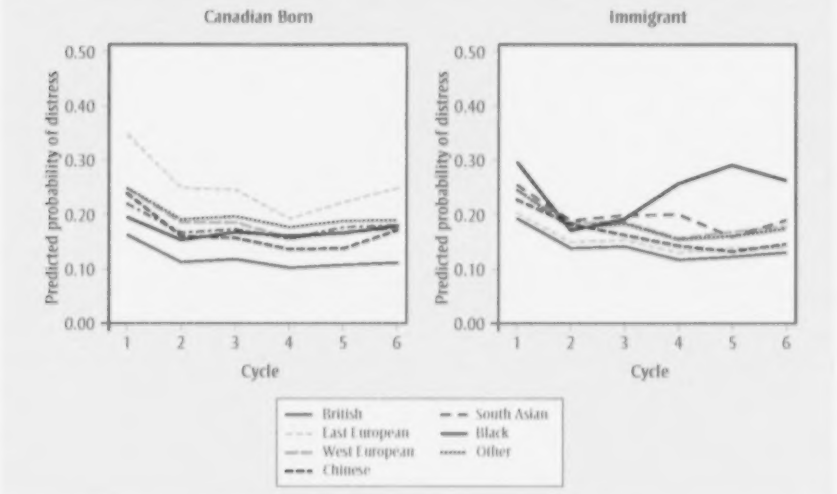
Combinations of variables		Adjusted odds ratio (OR_{adj}) of self-reported mental distress (95% CI)
Education (years) and ethnicity		
≤ 12 (vs. > 12)	Eastern European	0.81 (0.48–1.34)
≤ 12 (vs. > 12)	Western European	**0.88 (0.73–1.06)**[a]
≤ 12 (vs. > 12)	Chinese	2.16 (0.92–5.07)
≤ 12 (vs. > 12)	South Asian	0.83 (0.29–2.42)
≤ 12 (vs. > 12)	Black	0.40 (0.12–1.37)
≤ 12 (vs. > 12)	Other	1.03 (0.80–1.32)
SIS and ethnicity		
Low (vs. high)	Eastern European	1.11 (0.64–1.93)
Low (vs. high)	Western European	1.03 (0.80–1.33)
Low (vs. high)	Chinese	2.90 (0.71–11.88)
Low (vs. high)	South Asian	2.46 (0.62–9.80)
Low (vs. high)	Black	0.80 (0.25–2.51)
Low (vs. high)	Other	0.98 (0.71–1.35)
Moderate (vs. high)	Eastern European	1.51 (0.85–2.66)
Moderate (vs. high)	Western European	1.18 (0.89–1.55)
Moderate (vs. high)	Chinese	**5.67 (1.38–23.32)**
Moderate (vs. high)	South Asian	2.30 (0.64–8.27)
Moderate (vs. high)	Black	0.45 (0.10–2.07)
Moderate (vs. high)	Other	1.13 (0.81–1.57)
Immigration status and ethnicity		
Immigrant (vs. Canadian-born)	Eastern European	**1.80 (1.10–2.97)**
Immigrant (vs. Canadian-born)	Western European	**1.38 (0.97–1.96)**[a]
Immigrant (vs. Canadian-born)	Chinese	1.18 (0.55–2.53)
Immigrant (vs. Canadian-born)	South Asian	1.26 (0.35–4.57)
Immigrant (vs. Canadian-born)	Black	0.68 (0.15–3.08)
Immigrant (vs. Canadian-born)	Other	1.24 (0.88–1.74)
Sex and ethnicityy		
Female (vs. male)	Eastern European	**0.70 (0.47–1.04)**[a]
Female (vs. male)	Western European	0.98 (0.82–1.17)
Female (vs. male)	Chinese	0.73 (0.39–1.38)
Female (vs. male)	South Asian	**0.40 (0.15–1.07)**[a]
Female (vs. male)	Black	0.84 (0.22–3.16)
Female (vs. male)	Other	0.88 (0.70–1.13)
Drop and ethnicity		
Missing value, number		
1	Eastern European	1.10 (0.65–1.87)
1	Western European	1.10 (0.85–1.43)
1	Chinese	0.89 (0.39–2.05)
1	South Asian	0.80 (0.21–3.06)
1	Black	**5.25 (1.20–22.85)**
1	Other	0.90 (0.64–1.27)
≥ 2	Eastern European	1.26 (0.77–2.05)
≥ 2	Western European	**0.79 (0.63–1.00)**
≥ 2	Chinese	0.85 (0.42–1.71)
≥ 2	South Asian	**0.30 (0.09–1.04)**[a]
≥ 2	Black	0.95 (0.19–4.66)
≥ 2	Other	**0.77 (0.58–1.01)**[a]

Abbreviations: CI, confidence interval; OR_{adj}, adjusted odds ratio; SIS, social involvement score; vs., versus.

Note: Bolded values are statistically significant.

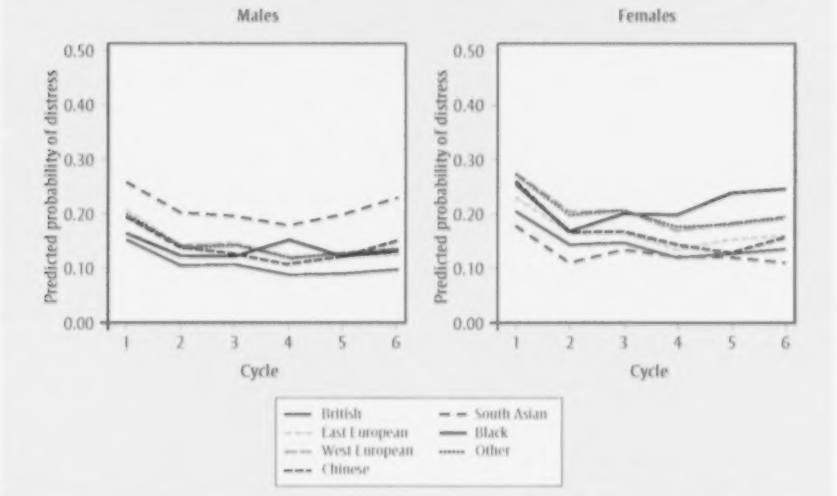
[a] Borderline significant.

FIGURE 1
Predicted probability of developing moderate/high mental distress over time among NPHS respondents aged 15 years plus stratified by ethnicity and immigration status, cycle 1 (1994/1995) to cycle 6 (2004/2005)



Abbreviation: NPHS, National Population Health Survey.

FIGURE 2
Predicted probability of developing moderate/high mental distress over time among NPHS respondents aged 15 years plus stratified by ethnicity, cycle 1 (1994/1995) to cycle 6 (2004/2005)



Abbreviation: NPHS, National Population Health Survey.

However, other studies have shown that this psychological stress does not improve over time.[14,31]

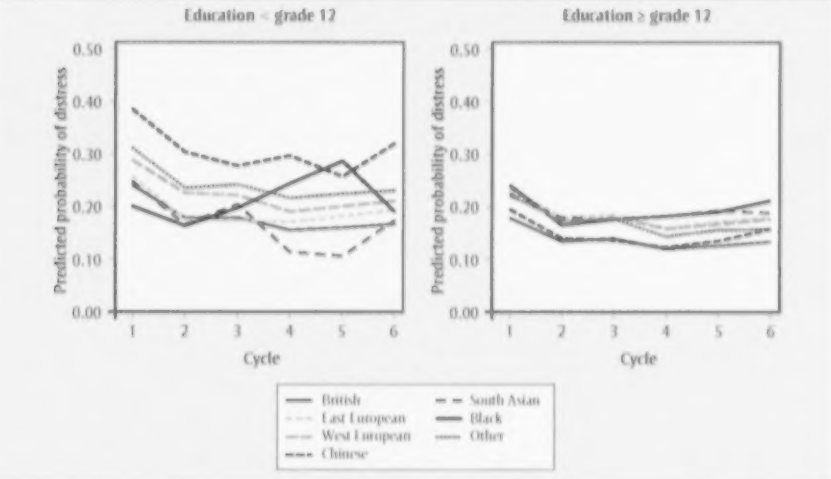
Our data did not show the significant interaction between age and ethnicity observed by Rait et al.;[29] rather, we observed a decline in moderate/high mental distress with increasing age (Table 1), a finding consistent with those of many other researchers.[4,14,30] Rait et al. also found poorer mental health among the older (65+ years) immigrants of Chinese ethnicity compared to the Canadian-born population, which our results did not show.[29] In this regard, because of the aging of the Canadian population, mental illness among elderly people is likely to be a major health problem, with a need for valid instruments to both assess the mental health of elderly people of different ethnicities and help in their treatment.[29]

Wu et al.,[31] who investigated the differences in mental distress of 12 ethnic groups using 1996/97 NPHS data, reported that Canadians of East and Southeast Asian, South Asian, Chinese and Black ethnic groups have a lower risk of depression compared to British Canadians.[31] These differences among ethnic groups persisted after adjusting for socio-economic status and social support.[31] We also observed that respondents of Chinese ethnicity with high SIS had the lowest moderate/high mental distress compared to other ethnicities and respondents of South Asian ethnicity had the second lowest moderate/highest mental distress (Table 3). Respondents of Chinese ethnicity with high SIS had remarkably low probability of moderate/high mental distress compared to those who had moderate SIS.

The inverse dose-response relationship between income adequacy and mental distress in our report (Table 2) supports the results from various Canadian, North American and British studies.[32,33] Orpann et al. reported that among both men and women low household income was a significant predictor for mental distress.[33]

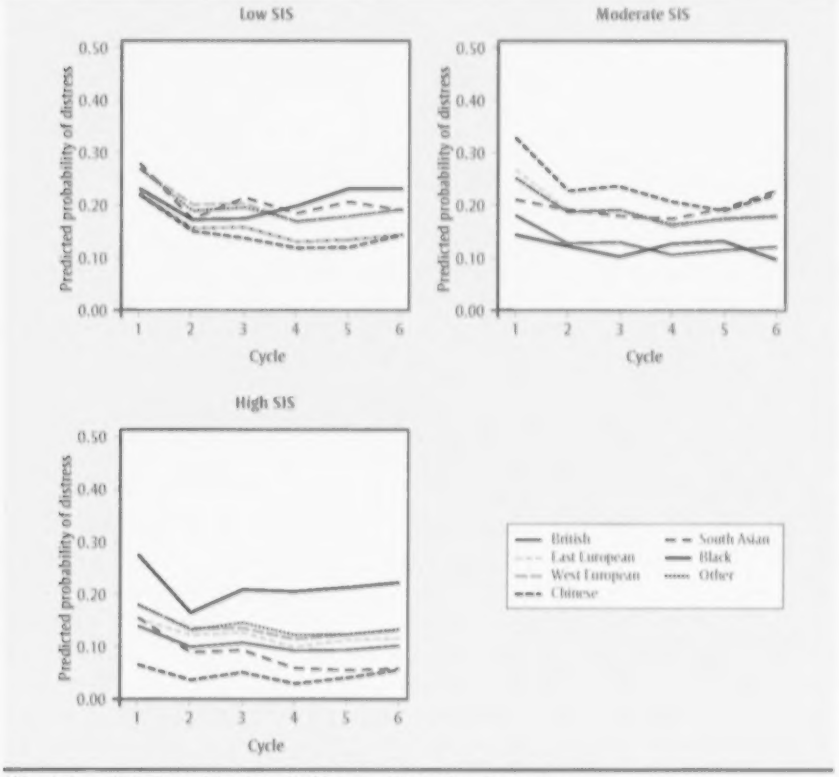
Personal smoking habits and exposure to second-hand smoke have been linked to mental health in several studies.[34,39] We found that both former and current smokers were significantly more likely to report moderate/high mental distress than non-smoking respondents, and that exposure to household smoking was significantly associated with increased risk of moderate/high mental distress (see Table 1). Evidence suggests that smoking may predate and may have a causal role in the development of mental disorders because of the complex effect of nicotine on neuroregulators.[40] Individuals with mental illnesses may "self-medicate" with tobacco.[41-43] Further research could

FIGURE 3
Predicted probability of developing moderate/high mental distress over time among NPHS respondents aged 15 years plus stratified by ethnicity and education level, cycle 1 (1994/1995) to cycle 6 (2004/2005)



Abbreviation: NPHS, National Population Health Survey.

FIGURE 4
Predicted probability of developing moderate/high mental distress over time among NPHS respondents stratified by ethnicity and social involvement score, cycle 1 (1994/1995) to cycle 6 (2004/2005)



Abbreviations: NPHS, National Population Health Survey; SIS, Social Involvement Score.

Note: For the low social involvement category, lines for British and Eastern European ethnicities overlap. For the moderate social involvement category, lines for Western European and Other ethnicities overlap.

investigate whether smoking causes mental distress or whether smoking is the result of mental health problems by comparing smoking patterns before and after incidences of mental distress.

Our findings echo those of Canadian and Australian studies reporting that the prevalence of depression or other mental disorders was significantly lower in rural populations.[44,45] We also observed that geographical area was a significant risk factor for mental distress. Caron and Liu reported that people living in Quebec demonstrated significantly higher psychological distress compared to those living in Atlantic Canada, Ontario, British Columbia and the Prairie provinces.[26] In contrast, Stephens et al. found no relationship between mental health and the province of residence.[14]

It is not clear why respondents of Black ethnicity with one missing observation had an extremely high probability of reporting moderate/high mental distress (Figure 5; Table 3). Similarly, the opposite finding for Chinese respondents for two or more missing observations and for those who had deceased during the study period is hard to explain.

Strengths and limitations

The strengths of our study were the availability of information on a large number of people over a 12-year period, the small attrition rate of respondents, and the large number of health determinants available for analysis. There were also some limitations. The NPHS survey includes respondents from all 10 Canadian provinces, but excludes people living in the territories, long-term residents of health institutions, individuals living on Indian Reserves and Crown Lands, and full-time members of the Canadian Forces. Since the prevalence of the mental distress may be higher in the excluded populations than the general population, the analysis could have underestimated the risk of moderate/high mental distress. In addition, data in this analysis relied on self-report, which always tends to be biased.

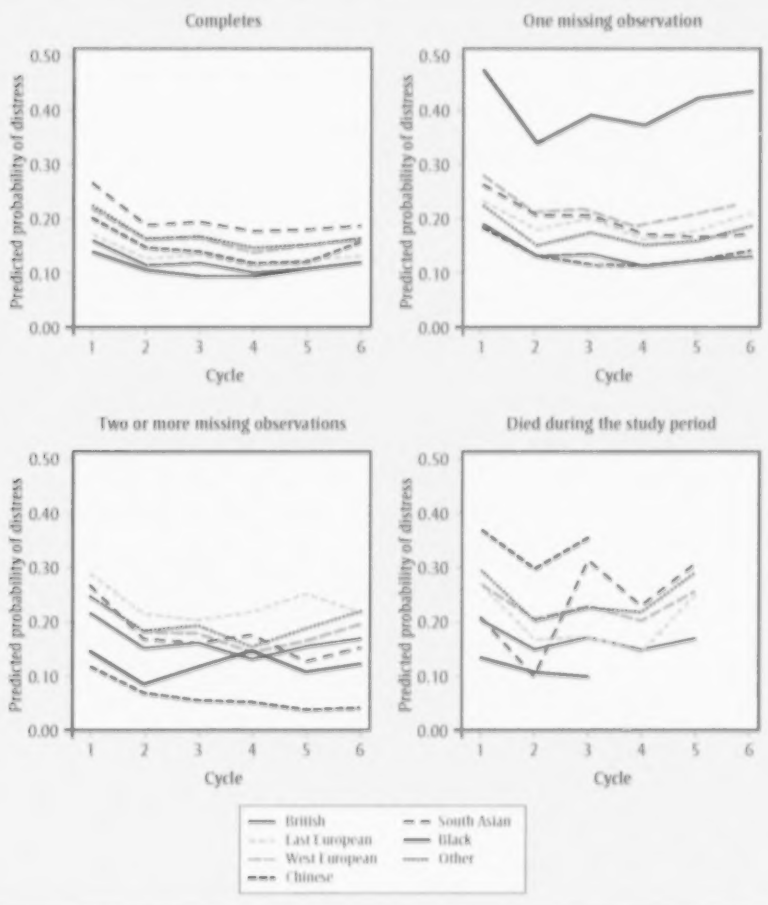
Increased prevalence of mental health problems in immigrant populations has been reported worldwide;[46,47] however,

rates are not consistently elevated in Canada.[48] Based on results from the Canadian Community Health Survey, recent first-generation immigrants to Canada had lower rates of depression compared to Canadian-born residents; however, these rates increased with length of stay in Canada and among the second generation.[7] The reason for the lower rates in the first generation could be because all applicants are screened for a wide range of health problems during the immigration process. It is also possible that recent immigrants do not seek help for mental health problems due to ethnic and cultural barriers. As their length of stay, comfort in Canadian society and awareness increases, they may seek the necessary help. Nevertheless, with immigrant population growth varying from 14% to 30% in different Canadian provinces, this remains a challenge for developing targeted mental health strategies.[48]

Conclusion

The results of our study show that the relationship between ethnicity and mental distress is modified by factors such as immigrant status (foreign born versus Canadian born), sex, education and SIS. The risk of reporting moderate/high mental distress was highest among those aged 15 to 24 years and in the low-income adequacy group. Marital status, sex, place and geographical area of residence as well as personal smoking and household smoking status were other significant predictors. Our results suggest that there is a need to develop ethnicity-specific mental-health programs targeting those with low education attainment and low social involvement. In addition, policies and programs should also be targeted towards women, the younger age group (15–24 years) and low-income adequacy groups.

FIGURE 5
Predicted probability of developing mental distress over time among NPHS respondents who participated in all the cycles from cycle 1 (1994/1995) to cycle 6 (2004/2005) stratified by ethnicity and dropout pattern



Abbreviation: NPHS, National Population Health Survey.

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